PRODUCT INVENTORY AND PROFITABILITY LINKS
A STUDY OF INDIAN INDUSTRIES

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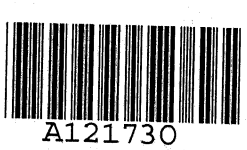

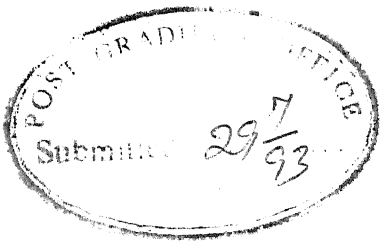

CERTIFICATE

It is certified that the work contained in the thesis entitled, "PRODUCT INVENTORY AND PROFITABILITY LINKS: A STUDY OF INDIAN INDUSTRIES" by Mr. Dheeraj Misra has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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SYNOPSIS

Name of Student : Dheeraj Misra Roll No.: 8810063

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This dissertation presents an analysis of the relationship between profitability and finished product inventory in different Indian industries at the firm level.

There are several factors which motivate a firm to hold inventory. Different economists have talked about different motives for holding of inventory such as to get cost advantage or price advantage or both. But the existing literature has so far ignored the impact of holding of inventory on the performance of the firm. Since performance of a firm is determined by cost and price together, therefore, there exists a relationship between holding of inventory and performance of the firm. How different motives of holding inventory eventually affect this relationship formed the important issue for investigation in the present thesis.

Five main motives for holding inventory were investigated in the study. They are economies of scale motive, increase in demand

motive, demand uncertainty motive, entry deterrent motive and speculative motive of inventory holding.

The first of these motives of inventory holding affects the average cost function of the firm while the remaining four motives affect the demand function of the firm.

Price-cost margin was taken as the measure of profitability. The relationship between price-cost margin and inventory holding was developed theoretically under each of the five motives separately. The theoretical model showed that inventory has a positive impact on the price-cost margin under all the motives except under reduction in demand uncertainty motive when the firm is a risk taker.

At the next stage, the relationship between the price-cost margin and inventory holding was studied empirically for different Indian industries at the firm level. The initial aim was to study the relationship empirically under each of the five motives separately. But it is very difficult to separate out the effect of inventory on price-cost margin under increase in demand motive, reduction in demand uncertainty motive and speculative motive of inventory holding. As a result of this, the impact of inventory on price-cost margin was not tested empirically under each motive separately.

Thus, in view of the above, the variation in the impact of inventory on price-cost margin was separated out under two effects

only, that is, (i) under the cost category of motives and (ii) under the demand category of motives of inventory holding. The first category incorporates the economies of scales motive reflecting the cost side while the second category incorporates all other motives of inventory holding taken together reflecting the demand side.

Time series data of firms of different Indian industries stretching over the period 1978-79 to 1988-89 covering production, sales, price, average cost, inventory etc. was collected. Demand and average cost functions were estimated for the firms and by using the parameters appearing in such functions, the impact of one unit change in inventory holding on price-cost margins of the firms were estimated separately for the cost category and the demand category.

Finally, a simple regression model was run in which price-cost margin was assumed to be a function of inventory holdings considering the demand and cost factors together. This was done to find the overall impact of inventory on the price-cost margin.

The basic sources of data for the empirical analysis were the Stock Exchange Official Directory, (1990) and 'Key Data on Large Business Units', published by the Centre for Monitoring Indian Economy, Bombay (1990). The sample for the purpose of this study

represented 85 firms of 21 Indian industries of the organised sector.

To study the empirical relationship, the industries were divided into four broad categories namely consumer non durable, consumer durable, producer non durable and producer durable product categories.

The results of the empirical analysis describing the relationship between inventory and price-cost margin under the cost category and the demand category separately showed that the cost impact is mostly positive for the consumer non durable, consumer durable and producer non durable industry groups while it is negative for some firms of the producer durable industry group. This result indicates the existence of economies of scale in the industries of the consumer non durable, consumer durable and producer non durable industry groups. The demand impact was observed to be positive for most of the firms of the consumer non durable group indicating that consumers respond to availability and there is favourable valuation of a firm's product by them. In the consumer durable industry group, the demand impact is mostly negative indicating the unintended accumulation of inventory by most of firms in this industry group. This might be due to a recessionary situation prevailing in most of the industries under this industry group during the eighties. In the producer non durable group, there are two industries namely paint and chemical industries in which the demand impact is mostly positive, while in

the case of cement and paper industries this impact is mostly negative. Thus, there is no clear cut trend of the demand impact visible in this industry group. In the producer durable product group the demand impact is again not clear. This implies an effective inventory management policy in some firms and the reverse in other firms of different industries in this group. Thus, in this industry group inventory management plays an important role and is a must to reduce any unintended accumulation of inventory. Besides this, the results showed that inventory is held by most of the firms of all industry groups to satisfy at least one motive of inventory holding, that is, to satisfy either the cost motive or the demand motive.

The empirical results of the full model showed that inventory has a positive impact on the price-cost margin in the case of all the firms comprising the industries of the consumer non durable broad category. In the case of the other industry groups the relationship between price-cost margin and product inventory is not clear. In the case of the consumer non durable industry group, inventory management does not have much role to play as the sales time of inventory is very small in this industry group and thus the relationship between price-cost margin and inventory does not differ from firm to firm. On the other hand, sales time of inventory is sufficiently large in the case of consumer durable, producer non durable and producer durable industry groups and thus inventory management has an important role to play in these

industry groups. It can be concluded from the regression results that the firms which have good inventory management show a positive impact of inventory on their price-cost margins and vice versa.

Further, the results obtained from the two approaches adopted for studying inventory-performance relationship (i.e. the disaggregated model approach and the full model approach) were compared. This comparison showed the disaggregated model to be superior to the full model.

The results of the study can help firms in deciding their inventory policy in such a way so as to increase their profit margins.

Dedicated

to

My mother - Smt. Girja Devi
and
My Father - Shri Anant Ram Misra

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Finally, I am deeply indebted to my wife Sangeeta who has calmly shared with me all the ordeals of research work. Without her help (both academic and moral) at crucial and difficult times, and her tolerance, this work would have been an impossibility.

(Dheeraj Misra)

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CHAPTER I

INTRODUCTION AND PROBLEM SETTING

1.1 INTRODUCTION

In the subject of inventory a lot of attention has been given to the problem of inventory management. Inventory management, which is a scientific device for controlling inventory cost and eliminating wastage is today regarded as an integral part of industrial management. Inventory management keeps the fact in view that the stock of inventory should be minimum in order to reduce the amount of funds locked in the form of inventory. That is, on the one hand, inventory management sees that adequate inventory is maintained to avoid stock-out and production hold up and on the other hand, it sees to the fact that excessive investment in inventory is avoided to reduce carrying cost and loss of profits. While there is a lot of literature available on the cost aspect of inventory, very little work has been done in the area of the relationship of inventory with profits. Even economic theory has neglected this aspect of inventory. In fact, economic theory has had remarkably little to say about inventory in general. This neglect is partly connected to the emphasis on equilibrium situations in which holding of inventory in anticipation of price changes is ruled out apriorily. In the equilibrium conditions we generally assume that whatever output is produced by a firm during a particular period is sold during that period. But even under static conditions it is usually agreed that inventory will be held in most circumstances inspite of

storage costs and the tying-up of capital which could be invested elsewhere. There must, therefore, be utilities derived from the holding of inventory which outweigh these costs. Consequently, there has been growing interest among economists in recent times regarding the different motives for holding of inventory.

Different economists have talked about different motives for holding of inventory such as to get cost advantage or price advantage or both, but they have not said anything about the impact of holding of inventory on the performance of the firm. Since performance of a firm is determined by cost and price together, therefore, there exists a relationship between holding of inventory and performance of the firm. How different motives of holding inventory eventually affect this relationship is an important issue for study with which we are concerned in this thesis. Before describing the objectives of this thesis is detail it would be quite useful for us to go through the different motives of inventory holding and their relevance in the context of the relationship between performance and inventory holding for the firm. It follows in the next section.

1.2 MOTIVES FOR HOLDING INVENTORY

Inventory holdings is one of the basic features of almost all the firms in the modern industrial world. Holding of inventory means incurring of extra expenses in terms of storage cost and blocking of capital for some period of time and thus losing a return on that. The firm holds inventory even after it incurs the above mentioned costs. Thus, inventory holding is profitable only

when a firm gets some advantages which outweigh these costs. The advantages which outweigh inventory costs, motivate the firm to hold inventory.

There are different motives for holding inventory. One of the main aims of firms for holding inventory is to enjoy economies of scale in their production process and/or in inventory holdings. According to Gravelle and Rees (1981), the decision whether to hold inventory or not, depends on the marginal cost of storage and the magnitude of production cost savings which inventory holdings permit. If the magnitude of production cost savings is more than the marginal cost of storage, a firm will hold a positive target level of inventory otherwise not.

Assume that the average cost of production is given as:

$$AC_Y = a_0 - a_1 Y , \qquad a_1 > 0 \tag{1.1}$$

where Y is the level of output and AC_Y denotes the average cost of production.

Further assume that the average cost of inventory holding is given as:

$$AC_F = b_0 + b_1 F \tag{1.2}$$

where F is the level of finished product inventory and AC_F is the average cost of inventory holdings.

The impact of one unit change in inventory on average cost of production is given as:

$$\frac{\partial AC_Y}{\partial F} = - a_1 \frac{\partial Y}{\partial F} \tag{1.3}$$

If we assume that the change in inventory is brought about only by changing output then we have:

$$\frac{\partial Y}{\partial F} = 1 \qquad (1.4)$$

Therefore, in this case,

$$\frac{\partial AC_Y}{\partial F} = -a_1 \qquad (1.5)$$

In equation (1.5) $-a_1$ represents the decrease in the average cost of production due to one unit increase in inventory holdings.

Similarly, the change in average cost of inventory due to one unit change in inventory is given as:

$$\frac{\partial AC_F}{\partial F} = b_1 \qquad (1.6)$$

In equation (1.6) if $b_1 < 0$, it implies that a firm is experiencing economies of scale in inventory holdings and economies of scale in production also (equation 1.5). In this case the firm will hold a positive target level of inventory. On the other hand, if $b_1 > 0$ in equation (1.6) it implies that the firm is experiencing economies of scale in the production process and diseconomies of scale in inventory holdings. In this case, the firm will hold inventory only if a_1 is greater than b_1 (that is, when the decrease in average cost of production is more than the increase in average cost of inventory holdings).

Another factor which motivates the firm to hold inventory is to stabilise its demand curve. A large inventory may provide assurance to the customers that desired supply will be available whenever they demand the product. The firm will have a good reputation among its customers. The customers will feel that the firm is a reliable supplier and this will increase the goodwill of the firm. Langlois (1989) has argued that demand for the product

is positively affected by the product availability and this motivates the firm to hold inventory. In other words, the possibility of inventory holdings may result in a favourable valuation of the firm's product by the consumers.

Randomness in the demand curves of firms is another motivating factor for inventory holdings. Randomness in the demand curve can impose large fluctuations in the production level and consequent cost of adjustment. Under these conditions the firm generally finds it worthwhile to reduce cost by smoothing out production and adopting an appropriate inventory policy. According to Blinder (1982), investment in inventory can be viewed as one of the several ways for a firm to acquire greater flexibility in reacting to unanticipated events. When output is not storable, firms can react to increase in demand only by raising prices or by boosting production. The more they do of one, the less they have to do of the other. On the other hand, price and output responses become smaller as output becomes more inventoriable. In other words, market price reacts more strongly to demand disturbances when inventories are exhausted than when they are available, that is, firms which operate with a little extra inventory will be able to cushion demand shocks with ease.

Another objective for holding inventory is to deter the entry of new firms. According to Ware (1985), a firm which has a large enough inventory can temporarily reduce the price and in this way drive out an entrant. Thus a sufficiently large stock of inventory will ensure a negative present value for the entrant. Hence entry can always be deterred by holding inventory. Entry of

new firms into the market can be expected whenever the existing firms are deriving profits from inventory holdings. However, the established firms in the market may fix lower prices for their product and/or overstate the accounting or logistic costs of inventory thus understating the profit potentials and creating a barrier to entry.

Last but not the least motive of inventory holdings is that, inventory is held when prices are low and sold off when prices rise. That is, a firm reduces sales in the current period and increases the stock of inventory in the expectation that this inventory can be disposed off in the future when the conditions would be favourable. This is the speculative motive of inventory holdings. The scope for speculation in inventories depends on several factors like nature of product, types of markets and prospective changes in the government's fiscal policies etc.

Thus, all or some of the above mentioned advantages motivates the firms to hold inventory. These advantages may be in the form of a decrease in the average cost of production (i.e. when a firm is experiencing economies of scale in its production process), a decrease in the average cost of inventory holdings (i.e. economies of scale in inventory holdings) and/or an increase in the price of the product. Holding of inventory is profitable only when these advantages compensate and outweigh the costs which arise due to inventory holdings. Thus a simple framework of the relationship between profitability (i.e. performance) and inventory holdings under different motives emerges from the above discussion.

The above discussion was related to intended (or planned) inventory only. But in some cases there might be an unintended accumulation of inventory also. Such unintended accumulation might arise due to inaccurate prediction of demand, unforeseen circumstances etc. Whenever there is an unintended inventory a producer wishes to dispose off this inventory at the earliest so as not to block capital any further. In such a situation there is an excess supply of the commodity in relation to its demand due to which consumers have a dominant position over the producer (unlike in the case of intended inventory) and this has a reducing effect on the price of the product. Thus we see that unintended (or involuntary) inventory accumulation by a firm also affects the profitability of the firm.

A simple measure of profitability is the price-cost margin. It is defined as the ratio of the difference between price and average cost to price. All those factors which affect either price or cost or both will affect the price-cost margin. The price variable is included in the demand function of the firm while the cost variable is included in the average cost function of the firm. Thus, we can say that all those factors which affect either the demand curve or the average cost curve of a firm or both will affect the price-cost margin of that firm. We are postulating inventory holding as one such factor in light of the above discussion.

As mentioned above inventory holding under different motives affects both the demand curve and the cost curve of the firm. Some general plausibilities for this may be summarised as follows:

(i) If inventory is held to enjoy economies of scale in the production process, an increase in inventory holdings reduces the cost of production.

(ii) If demand for the product is positively affected by the product availability, an increase in inventory holdings will shift the demand curve to the right and thus a firm will get price advantage.

(iii) If inventory is held to reduce the randomness in the demand curve, inventory holdings will affect the demand curve.

(iv) If inventory is held to deter the entry of new firms, inventory holdings will affect the demand curve.

(v) If inventory is held when prices are low and sold off when prices rise, an increase in inventory holdings will shift the demand curve to the right in the current period because consumers know that price will rise in the future period.

All these generalizations regarding the shifts of demand and cost curves as a result of inventory holding will have implications for price-cost margin of the firms and therefore, as mentioned earlier, the relationship between price-cost margin, that is, profitability of the firm and inventory holdings emerges on the surface.

.3 A REVIEW OF THE LITERATURE

The major studies on inventory have so far been Arrow, Harris and Marchan (1951), Mill (1962), Arvan and Moses (1982), Calvo and

Thoumi (1984), Langlois (1989), Maccini (1984), Ware (1985), Blinder (1982) and Reagan (1982). These works have concentrated mostly on identifying the motives of inventory holdings. The focus of all these studies is that inventory is held either to enjoy economies of scale in the production process (Banerji, 1990; Carlton, 1989; Gravelle and Rees, 1981; Arvan, 1982; Arvan and Moses, 1982; Arrow, Harris and Marchan, 1951; Hay, 1970; Nguyen, 1976; Philips, 1983; Topel, 1982; Bresnahan and Suslow, 1985), or to stabilise the demand curve (Langlois, 1989; Rossana, 1984; Mill, 1962; Zabel, 1972; Maccini, 1984; Spulber, 1985; Wright and Williams, 1984), or to reduce the randomness in the demand curve (Blinder, 1982; Reagan, 1982; Calvo and Thoumi, 1984; Amihud and Mendelson, 1983; Rotemberg and Saloner, 1987; Carlton, 1989), or to deter the entry of new firms (Ware, 1985), or for speculative gains associated with price fluctuations (Rowley and Trivedi, 1975). Such studies however have failed to focus attention on finding out the impact of inventory holding on the performance (i.e. price-cost margins) of the firms. One may infer indirectly about such impacts through achievement of the motives of inventory holding but this is not enough. An explicit analysis of this kind is very much needed to examine the precise role of inventory decisions by the firms. The studies cited above are more or less theoretical deductions on motives of inventory holding. Their empirical counterparts have not been examined. Particularly, the empirical work on establishing the relationships between performance and inventory holding at the firm level is not existing at present with the exception of Langlois (1989) and

Amihud and Mendelson (1989). Langlois examined empirically the links between the mark-up (i.e. profit margin) and inventory holding of the firms. According to her, the firm chooses target inventory together with selling price so as to maximise average per unit time profit. The optimisation yields a mark-up over direct cost (i.e. $\frac{P-AC}{P}$) equal to the inverse of the price elasticity of sales time for the firm's inventory, $\frac{1}{\epsilon}$. She found that empirical estimates of $1/\epsilon$ are not significantly different from true mark-ups in a statistical sense. Amihud and Mendelson, in their study, examined the relationship between the market power (using Lerner index and market share of the firm as a measure of market power) of a firm and the level and variability of its inventories. They found that firms with greater market power hold more inventories and their inventories are more volatile. This is a pioneering study of its kind having potential to influence the inventory linked price-cost margin studies in future. Other studies like Blinder (1982) did link inventory holding with profit maximizing goal but they are in the traditional line of inventory management rather than finding the impact of inventory holding on the performance of the firms. There is a need of this kind of study in order to understand inventory behaviour of the firms in a broader sense. This is the task that is being pursued in this thesis.

1.4 EMPHASIS IN THE PRESENT STUDY

In the light of the above discussion, the present study makes an attempt to find out the impact of inventory holdings in the

Indian industries on their price-cost margins. The focus is on development of a theoretical model to find out the relationship between price-cost margin and inventory holdings and to test it empirically for a few leading Indian industries using the econometrics technique. Investment in inventory means that the firm is blocking some capital for a certain period of time. Therefore it is necessary that a firm should get some return on this type of investment. Bresnahan and Suslow (1985) have argued that as long as positive inventories are being held, their holder should earn on the funds invested on them at the competitive rate of return. That is, the rate of return should be equal to the market rate of interest. Using the price-cost margin as a measure of overall rate of return from the business, the objective of this study is to see how such rate of return is affected by inventory holdings under different motives of the firms in Indian industries. Thus, we have a simple hypothesis for testing, that is, price-cost margin of the firm is a function of its inventory holdings. The emphasis in this analysis is on studying the effect of a change in inventory holdings of the firms of different industries on their price-cost margins using time series data.

On the theoretical side, as already mentioned, different economists have talked only about different motives of inventory holdings. By using the theoretical literature available on the different motives of inventory holdings, we have developed a theoretical framework to find out the impact of inventory holdings on the price-cost margin under each of the motives separately as well as under all the motives taken together. Thus for this study

we have developed our theoretical framework and further have also tested it empirically using available data of some leading Indian industries at the firm level. However, when testing the model empirically we have considered only two factors separately viz. the cost factor and the demand factor. The cost factor incorporates the economies of scale motive of inventory holding whereas the demand factor incorporates the increase in demand motive, demand uncertainty motive, entry deterrent motive and speculative motive of inventory holding.

This has been done because the impact of the motives which affect the demand function viz. increase in demand,reduction in demand uncertainty, entry deterrent and speculative motives on the price-cost margin cannot be separated out. The details of this are provided in Chapter 4. Besides this, the demand uncertainty, entry deterrent and speculative motives also have measurement problems associated with them. Thus, empirical investigations for the purpose of this study have been restricted to two factors mentioned above (i.e. the cost factor and the demand factor) plus both the cost factor and the demand factor of inventory holdings taken together.

This study will bring out a number of things. Firstly it will show what are the motives for holding inventory at the firm level. Since all the motives of inventory holdings either affect the demand curve or the cost curve or both, we shall also get information about the nature of the demand curve and the cost curve at the firm level.

Secondly studying the relationship that exists between the price-cost margin and inventory holdings under each of the above mentioned two factors will show which factor of inventory holding is better in terms of short term profitability.

Thus the objective of this study, that is, finding out the impact of inventory holding on the price-cost margin will describe almost the full nature of the firm and industry. Further, there are no studies related specifically to this topic in the Indian context. Such a study can therefore prove to be of importance.

1.5 OUTLINE OF THE STUDY

This study consists of six chapters. Chapter 2 provides the theoretical framework describing the relationship between the price-cost margin and finished product inventory under different motives of inventory holding as mentioned above.

Chapter 3 explains the methodology for empirical analysis and the data base of the study.

Chapter 4 is devoted to the empirical investigation of the relationship between the price-cost margin and finished product inventory in different Indian industries at the firm level. This analysis has been done for each of the two factors explained above, that is, the cost factor (which incorporates the economies of scale motive of inventory holdings) and the demand factor (which incorporates the remaining motives of inventory holdings).

Chapter 5 examines the empirical relationship between the price-cost margin and inventory holdings without considering the

CHAPTER 2

THEORETICAL FRAMEWORK OF THE STUDY

As mentioned in Chapter 1, the focus of this study is on identifying the effects of inventory holdings under different motives on profitability of selected Indian firms. The need for a study of the relationship between profitability (that is, price-cost margin) and inventory holding under different motives in the Indian context has been emphasized in the opening chapter of this thesis. In this chapter we present the theoretical foundations for such relationships. This kind of analysis helps in identifying the textable propositions or hypotheses of this study which will be empirically tested in the following chapters.

2.1 INTRODUCTION

As described in the first chapter, the price-cost margin is defined in terms of a profit rate which expresses total profit as a percentage of sales.

Mathematically it can be expressed as:

$$Z = \frac{R-C}{R} \qquad (2.1)$$

where R is the total revenue

C is the total cost of sales and

Z is the price-cost margin.

Total revenue is defined as the price multiplied by the volume of output sold and total cost of sales is defined as the average cost multiplied by volume of output sold. Therefore, price-cost margin

Z can also be written as:

$$Z = \frac{P.S - AC.S}{P.S.}$$

or

$$Z = \frac{P - AC}{P} \qquad (2.2)$$

where P is the price, AC is the average cost and S is the output sold.

Thus from equation (2.2) it is clear that the price-cost margin is either determined by price of the product or average cost of production or both. Therefore, all those factors which affect either price or average cost or both will affect the price-cost margin. As described in the first chapter, inventory affects both price and cost, therefore, inventory holdings is a determinant of the price-cost margin.

Since there are very few studies in the literature related specifically to this topic, it would be worthwhile to develop theoretically the kind of relationship that can generally be expected between inventory holdings and price-cost margin. The relationship may be either positive or negative under different conditions.

We know that

$$Z = f(F) \qquad (2.3)$$

where F is the finished goods inventory and Z is the price-cost margin.

By substituting expression (2.2) in expression (2.3) we get the following:

$$\frac{P - AC}{P} = f(F) \qquad (2.4)$$

The relationship between the price-cost margin and inventory

holdings can be found out by differentiating price-cost margin (Z) with respect to inventory holdings (F). If the derivative of price-cost margin with respect to inventory holdings is greater than zero (that is, $\frac{\partial Z}{\partial F} > 0$), we say that there is a positive relationship between the price-cost margin and inventory holdings. On the other hand, if the derivative of price-cost margin with respect to inventory holdings is less than zero (that is, $\frac{\partial Z}{\partial F} < 0$), we say that there is a negative relationship between the price-cost margin and inventory holdings.

By differentiating price-cost margin (Z) with respect to inventory holdings (F), we get

$$\frac{\partial Z}{\partial F} = \frac{\partial\left(\frac{P - AC}{P}\right)}{\partial F}$$

$$= \frac{\partial\left(1 - \frac{AC}{P}\right)}{\partial F}$$

$$= -\frac{P.\frac{\partial AC}{\partial F} - AC.\frac{\partial P}{\partial F}}{P^2}$$

$$= \frac{AC.\frac{\partial P}{\partial F} - P.\frac{\partial AC}{\partial F}}{P^2} \qquad (2.5)$$

For the existence of a positive relationship between the price-cost margin and inventory holding, we must have

$$\frac{\partial Z}{\partial F} > 0$$

or $$\frac{AC.\frac{\partial P}{\partial F} - P.\frac{\partial AC}{\partial F}}{P^2} > 0 \qquad \text{[from expression 2.5]}$$

or $$AC.\frac{\partial P}{\partial F} - P.\frac{\partial AC}{\partial F} > 0$$

or $$AC.\frac{\partial P}{\partial F} > P.\frac{\partial AC}{\partial F}$$

or $$\frac{F}{P} \cdot \frac{\partial P}{\partial F} > \frac{F}{AC} \cdot \frac{\partial AC}{\partial F}$$

or $$\eta_{P.F} > \eta_{AC.F} \qquad (2.6)$$

where $\eta_{P.F} = \frac{F}{P} \cdot \frac{\partial P}{\partial F}$, which is inventory elasticity of price, and

$\eta_{AC.F} = \frac{F}{AC} \cdot \frac{\partial AC}{\partial F}$, which is inventory elasticity of average cost.

Thus there will be a positive relationship between the price-cost margin and inventory holdings if inventory elasticity of price is greater than inventory elasticity of average cost. In other words, there will be a positive relationship between the price-cost margin and inventory holdings if and only if the percentage change in price due to one percent change in inventory holdings is greater than the percentage change in average cost due to one percent change in inventory holdings.

As described in the first chapter, there are different factors in the literature which motivate the firm to hold inventory. For the sake of clarity we repeat them here. These motives are:

(i) Inventory is held to enjoy advantage of economies of scale in the production process;

(ii) Demand for the product is positively affected by the product availability and this motivates the firm to hold inventory;

(iii) Inventory is held to reduce randomness in the demand curve;

(iv) Inventory is held to deter the entry of new firms; and

(v) Inventory is held when prices are low and sold off when prices rise.

In the next sections, the kind of relationship that can generally be expected between price-cost margin and inventory holdings under each of the above mentioned motives will be discussed theoretically.

2.2 INVENTORY AND ECONOMIES OF SCALE

One of the main aims of a firm to hold inventory is to enjoy advantage of economies of scale in the production process. If the firm is experiencing economies of scale in its production process, it may be profitable for the firm to produce in excess of its total sales in order to exploit the resources in an efficient way. According to Carlton (1989), an industry that produces to stock will be able to take the advantage of economies of scale more than an industry that produces to order.

Economies of scale means a reduction in average cost of production as the level of output is expanded. Thus, the cost curve is said to exhibit economies of scale if the long run average cost curve is falling with increasing output. At the point where the average cost of production is minimum, it is said that a firm is utilising the whole of its installed capacity. Over the falling portion of the average cost curve there is an underutilisation of the installed capacity and over the rising portion of average cost curve, there is an overutilisation of the installed capacity.

Thus, a firm is experiencing economies of scale if average cost of production is falling or capacity utilisation is less than 100 percent.

If a firm is experiencing economies of scale in the production process, it can reduce the average cost of production by producing in excess of its total sales. For a given level of price, a decrease in the average cost of production means an increase in profit. This can be understood clearly with the help of the following diagram.

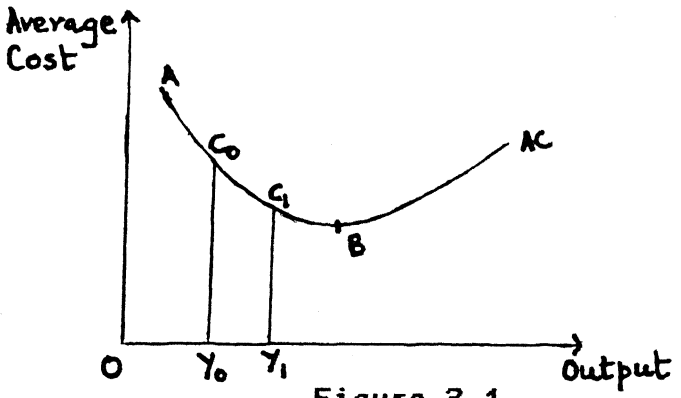

Figure 2.1

In Figure 2.1, AC is the average cost curve of the firm. Suppose that OY_0 amount of output of the firm is the current demand of that firm's product in the market. If the firm produces in excess of OY_0, it will increase its inventory. Over the range AB, an increase in inventory will reduce the average cost of production. Suppose the firm produces OY_1 amount of output. By producing excess output equal to Y_0Y_1, the firm reduces its average cost of production from C_0Y_0 to C_1Y_1. Thus, if the firm is experiencing economies of scale in the production process an increase in inventory holding (equal to Y_0Y_1) will reduce the average cost of production (from C_0Y_0 to C_1Y_1).

Holding of inventory means incurrence of extra expenses in terms of storage cost and interest cost (that is, inventory holding costs). Thus economies of scale motive is valid only when advantages accruing from reduction in the average cost of production outweighs these inventory holding costs. If the firm is also experiencing economies of scale in inventory holdings, an increase in inventory holdings means a reduction in both average cost of production and average cost of inventory holdings and thus inventory holdings is profitable for the firm. On the other hand, if the firm is experiencing economies of scale in the production process and diseconomies of scale in inventory holding, holding of inventory is profitable only when the reduction in the average cost of production is more than the increase in the average cost of inventory holding.

If we assume that the average cost function of a firm is linear, the firm will be experiencing economies of scale if the slope of the average cost curve is negative, that is, if the average cost of production is a decreasing function of output. Mathematically, as briefly mentioned in Chapter 1, let the average cost of production function of a firm be given as:

$$AC_Y = a_o + a_1 Y, \qquad \text{with } a_1 < 0 \qquad (2.7)$$

where AC_Y is the average cost of production and Y is the level of output.

By assigning a negative value to a_1, we assume that the firm is experiencing economies of scale in the production process.

Further assume that the average cost of inventory holding of the firm is a linear function of inventory holdings. That is,

$$AC_F = b_o + b_1 F \tag{2.8}$$

where AC_F is average cost of inventory holdings and

F is the finished product inventory.

By differentiating average cost of production function with respect to F we get

$$\frac{\partial AC_Y}{\partial F} = a_1 \frac{\partial Y}{\partial F} \tag{2.9}$$

If we assume that change in inventory is brought about only by changing output then the following condition must hold:

$$\frac{\partial Y}{\partial F} = 1 \tag{2.10}$$

Therefore in this case –

$$\frac{\partial AC_Y}{\partial F} = a_1 \tag{2.11}$$

Thus, if we increase inventory by one unit, average cost of production is reduced by $|a_1|$ units.

By differentiating average cost of inventory holdings function with respect to F, we get –

$$\frac{\partial AC_F}{\partial F} = b_1 \tag{2.12}$$

If $b_1 < 0$ that is, if the firm is also experiencing economies of scale in inventory holdings, holding of inventory is profitable. If $b_1 > 0$ that is, if a firm is experiencing economies of scale in the production process and diseconomies of scale in inventory holdings,holding of inventory is profitable only when $|a_1| > |b_1|$.

As described earlier, all those factors which affect either price or cost or both affect the price-cost margin. We see that economies of scale motive of inventory holdings affects the average cost of production, thus, there exists a relationship between the price-cost margin and inventory under economies of scale motive of inventory holdings.

Assume that the demand curve shows that price is an inverse function of volume of sales. That is, the demand function is:

$$P = \alpha - \beta S, \qquad \text{with } \beta > 0 \qquad (2.13)$$

where P is the price and

S is the volume of sales.

We also assume that the average cost is a function of volume of output produced. That is, the average cost function is:

$$AC = a_0 + a_1 Y, \qquad \text{with } a_1 < 0 \qquad (2.14)$$

where AC is the average cost of production which also includes inventory carrying cost and Y is the output produced.

In equation (2.14) a_1 is the change in average cost of production due to one unit change in output. By giving a negative value to a_1 we assume that the firm is experiencing economies of scale in the production process even after considering inventory carrying cost.

The finished product inventory (F) has not been included in the average cost function. This has been done because whenever there is any increase in cost (including the inventory carrying cost), it is distributed over the entire production and not just

the level of inventory. Whenever the firm plans to increase the finished product inventory through increase in production, it increases production cost, storage cost, interest cost etc. All these costs are distributed over the entire production and thus the level of production is shown as a variable in the average cost function and the effect of inventory on average cost is judged through increase in output. This has also been done to avoid the problem of multicollinearity between inventory (F) and production (Y).

A change in inventory can be brought about either by changing output or by changing sales. When the inventory is held to enjoy the advantage of economies of scale, a change in inventory is brought about only by changing output. That is, one unit change in inventory means one unit change in the level of production. That is,

$$\delta Y = \delta F = 1 \qquad (2.15)$$

There exists an identity which describes the relationship between output, sales and change in inventory –

$$\text{Identity : } Y = S + \Delta F \qquad (2.16)$$

Thus the relationship between the price-cost margin and inventory holdings under economies of scale motive can be studied under the assumption that change in inventory is brought about only by changing production.

Price-cost margin Z is defined as:

$$Z = \frac{P - AC}{P} = 1 - \frac{AC}{P} \qquad (2.17)$$

$$= 1 - \frac{a_0 + a_1 Y}{\alpha - \beta S} \qquad \text{[from expressions (2.13) and (2.14)]}$$

By differentiating Z with respect to F we get:

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S)\ (a_1 \frac{\partial Y}{\partial F}) - (a_0 + a_1 Y)\ (-\beta \frac{\partial S}{\partial F})}{(\alpha - \beta S)^2} \qquad (2.18)$$

If a change in inventory is brought about only by changing output, then we have -

$$\frac{\partial Y}{\partial F} = 1 \text{ and } \frac{\partial S}{\partial F} = 0$$

$$\text{Therefore, } \frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S)(a_1)}{(\alpha - \beta S)^2} \qquad (2.19)$$

$$= - \frac{a_1}{(\alpha - \beta S)} \qquad (2.20)$$

Since a_1 is negative therefore expression (2.20) is positive.

$$\text{Thus we get } \frac{\partial Z}{\partial F} = \frac{-a_1}{(\alpha - \beta S)} > 0 \qquad (2.21)$$

Thus there is a positive relationship between the price-cost margin and inventory holdings if inventory is held to enjoy the advantage of economies of scale in the production process.

2.3 INVENTORY AND INCREASE IN DEMAND

Another factor which motivates a firm to hold inventory is to stabilise it's demand curve. A large inventory may provide assurance to the customers that desired supply will be available whenever they demand the product. The firm will have a good reputation among its customers. The customers will feel that the firm is a reliable supplier and this will increase the goodwill of the firm. According to Spulber (1985) the firm faces financial risk due to the cost of unsatisfied consumer demand resulting from

insufficient inventory. Thus, by holding sufficient amount of inventory, the firm can keep its customers happy. Langlois (1989) has argued that demand for the product is positively affected by the product availability and this motivates the firm to hold inventory. According to Rossana (1984) the firm's expected inflow of orders depends on the stock of inventory that it holds. Thus, the possibility of inventory holdings may result in a favourable valuation of the firm's product by the consumers. In other words, by holding sufficient amount of inventory, the firm can shift the demand curve of its product to the right. This can be understood clearly with the help of the following diagram

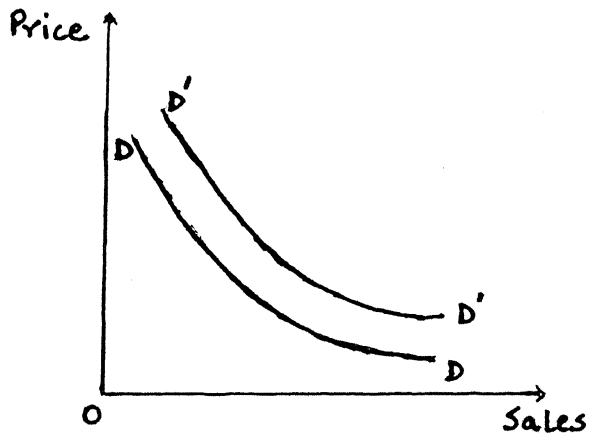

Figure 2.2

In Figure 2.2, DD is the initial demand curve of the firm's product when the firm does not hold any inventory. When the firm starts holding inventory, more consumers are attracted towards the firm's product because they feel confident of desired supply of the product being available and this shifts the demand curve of the firm's product to the right, that is to D' D' .

If the firm increases the stock of inventory to achieve the demand stabilisation motive this will also have an impact on both

the average cost of production and the average cost of inventory holdings. Thus inventory holdings under the demand stabilisation motive is profitable only if the advantages accruing from this motive outweighs the costs from the same.

Since the demand stabilisation motive affects both price and average cost, there exists a relationship between the price-cost margin and inventory holdings under this motive.

Let us assume that the demand curve shows that price is an inverse function of the volume of sales and a direct function of the volume of inventory. That is:

Demand Function : $P = \alpha - \beta S + \gamma F$, where $\beta > 0, \gamma > 0$ (2.22)

By assigning a positive value to γ we assume that the demand for the product is positively affected by the product availability.

We further assume that average cost is a function of the volume of output produced. That is:

$$AC = a_0 + a_1 Y \qquad (2.23)$$

Here we are not assigning any specific sign to a_1. If a_1 is negative it means that a firm is experiencing economies of scale in the production process and vice versa. When the firm holds inventory in the expectation that consumers respond to availability, it means that the firm is producing in excess of its estimated sales. In other words, this implies that in this case also any change in inventory is brought about by changing production only. That is:

$$\partial Y = \partial F = 1$$

Price-cost margin Z is defined as:

$$Z = 1 - \frac{AC}{P}$$

$$= 1 - \frac{a_0 + a_1 Y}{\alpha - \beta S + \gamma F} \quad \text{[from expressions (2.22) and (2.23)]}$$

The relationship between the price-cost margin and inventory holding can be studied by differentiating Z with respect to F. That is -

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S + \gamma F)a_1 - (a_0 + a_1 Y)\gamma}{(\alpha - \beta S + \gamma F)^2} \qquad (2.24)$$

Expression (2.24) contains the impact of inventory holdings on the price-cost margin under both the increase in demand motive as well as the economies of scale motive. The impact of inventory holdings on the price-cost margin under the economies of scale motive (as can be seen from expression 2.19) is:

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S)a_1}{P^2} \qquad (2.25)$$

Thus, the effect of one unit change in inventory holding on the price-cost margin due to increase in demand motive only can be found out by subtracting expression (2.25) from expression (2.24). That is -

$$\left(\frac{\partial Z}{\partial F}\right)^{\text{Inc.in dem.}} = \frac{(a_0 + a_1 Y)\gamma}{P^2} \qquad (2.26)$$

where $\left(\frac{\partial Z}{\partial F}\right)^{\text{Inc.indem.}}$ is the effect of one unit change in inventory on the price-cost margin due to increase in demand motive only. In expression (2.26) since γ is greater than zero, therefore, there is a positive relationship between the price-cost margin and inventory holding under increase in demand motive.

2.4 INVENTORY AND DEMAND UNCERTAINTY

Randomness in the demand curve of a firm is another motivating factor for inventory holdings. Randomness in the demand curve can impose large fluctuations in the production level and consequent cost of adjustment. Even under these conditions the firm generally finds it worthwhile to reduce cost by smoothing out production and adopting an appropriate inventory policy. A sizeable and interesting literature treats the dynamics of quantity and price adjustment, when a firm faces demand shocks and can smooth its price path and its production path through inventory holding. For instance Blinder (1982) analyses how a monopolist's production, inventories and price adjust to demand shocks depending on whether these shocks are transitory or permanent. According to him, investment in inventories can be viewed as one of the several ways for a firm to acquire greater flexibility in reacting to unanticipated events. He further says that when output is not storable, firms can react to increase in demand only by raising price or by boosting production. The more they do of one, the less they have to do of the other. On the other hand, price and output responses become smaller as output becomes more inventoriable. He assumes that in each period the marginal cost of production is increasing with output. Because of the cost convexity, the monopolist prefers a deterministic production to a random one with the same mean. In an intertemporal context, this means that he prefers a stable production to a fluctuating one. Thus, he would like to smooth demand shock over time; this is exactly what inventories allow him

to do. Consider first a transitory (single period) upward shock in demand. In Blinder's model (Blinder 1982), in the absence of inventories, the price and output adjust upward. They still do so in the presence of inventories but to a lesser extent. The firm can reduce its inventory temporarily and replenish it later. The effect of a single period increase in demand can thus be spread at the production stage over several periods. A permanent shock in demand cannot be smoothed as much. A high demand today implies a high demand in the future. That is, the marginal cost of production will be high tomorrow as well. Thus, production reacts more to a permanent shock than to a transitory shock. According to Reagan (1982), market price reacts more strongly to demand disturbances when inventories are exhausted than when they are available. Similarly, according to Carlton (1989), firms which operate with a little extra inventory will be able to cushion demand shocks. Thus we see that inventory holdings can reduce the randomness in the demand curve.

Since demand function is random, price does not depend only on volume of sales but also on random disturbance term u. To study the relationship between the price-cost margin and inventory holdings, the following functions are constructed:

Demand Function : Let price be a function of volume of sales and random disturbance term.

$$P = \alpha - \beta S + u, \quad u \sim N(0,\sigma^2) \qquad (2.27)$$

Inventory is held to reduce the randomness in the demand curve. That is, σ^2 (i.e. variance in price) varies inversely with

inventory holdings –

$$\sigma^2 = \gamma_0 - \gamma_1 F, \qquad \gamma_1 > 0 \tag{2.28}$$

The firm may be a risk averter or risk taker or risk neutral. A risk averter firm is that firm whose demand curve lies left to the expected demand curve. A risk taker firm is one whose demand curve lies to the right of the expected demand curve. A risk neutral firm is one whose demand curve lies on the expected demand curve. That is demand function for the three cases are –

$P = \alpha - \beta S + \lambda\sigma^2$, $0 < \lambda < 1$, if the firm is a risk taker (2.29)

$P = \alpha - \beta S - \lambda\sigma^2$, $0 < \lambda < 1$, if the firm is a risk averter

(2.30)

$P = \alpha - \beta S$, if the firm is risk neutral (2.31)

Formulations (2.29), (2.30) and (2.31) are based on the assumption that whenever there is an uncertain increase in demand, the risk taking firm tries to take the advantage of this increase in demand by increasing price. On the other hand, risk averter and risk neutral firms do not take this advantage because they fear losing their goodwill in the market if they do so. These demand functions have been formulated without considering the role of inventory. The role of inventory comes in expression (2.28) where it is shown that large inventory holding by the firm reduces the variation in price. Thus, it is through expression (2.28) that inventory is affecting the demand function under demand uncertainty motive of inventory holding.

Average Cost Function : Let average cost of output depend on the level of output. That is –

$$AC = a_o + a_1 Y \qquad (2.32)$$

Here the firm after estimating the volume of sales, produces in excess of its estimated sales to meet any uncertainty in demand. This implies that here also a change in inventory is brought about only by changing the level of production. That is –

$$\delta Y = \delta F = 1$$

Identity: There exists a well known identity which describes the relationship between the level of output, volume of sales, inventory level in the beginning of the period and inventory level at the end of the period. That is,

$$Y_t = S_t + F_t - F_{t-1} \qquad (2.33)$$

where Y_t is the output produced in period t

S_t is the volume of sales in period t

F_t is the finished product inventory at the end of period t

and

F_{t-1} is the finished product inventory at the beginning of period t.

Thus, the relationship between the price-cost margin and inventory holdings under demand uncertainty motive can be studied under the following three cases:

(i) when the firm is a risk averter,

(ii) when the firm is a risk taker,

(iii) when the firm is risk neutral.

Case 1 : When the firm is a risk averter.

We know that price-cost margin Z is defined as:

$$Z = 1 - \frac{AC}{P}$$

$$= 1 - \frac{a_0 + a_1 Y}{\alpha - \beta S - \lambda\sigma^2} \quad \text{[from expressions (2.30) and (2.32)]}$$

$$= \frac{a_0 + a_1 Y}{\alpha - \beta S - \lambda\gamma_0 + \lambda\gamma_1 F} \quad \text{[from expression (2.28)]} \qquad (2.34)$$

The relationship between the price-cost margin and inventory holdings can be studied by differentiating Z with respect to F. That is,

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S - \lambda\gamma_0 + \lambda\gamma_1 F)a_1 - (a_0 + a_1 Y)\lambda\gamma_1}{(\alpha - \beta S - \lambda\gamma_0 + \lambda\gamma_1 F)^2} \qquad (2.35)$$

When there was no demand uncertainty, the value of $\frac{\partial Z}{\partial F}$ was -

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S)a_1}{(\alpha - \beta S)^2} \quad \text{[See expression (2.19)]} \qquad (2.36)$$

Thus the effect of one unit change in inventory holding on the price-cost margin due to reducing demand uncertainty motive can be found out by subtracting expression (2.36) from expression (2.35). That is,

$$\left.\frac{\partial Z}{\partial F}\right]^{\text{D.U.\& R.A.}} = \frac{(a_0 + a_1 Y)\lambda\gamma_1}{P^2} \qquad (2.37)$$

where $\left.\frac{\partial Z}{\partial F}\right]^{\text{D.U.\& R.A.}}$ describes the relationship between the price-cost margin and inventory holding when inventory is held to reduce randomness in the demand curve and the firm is a risk averter. Since both λ and γ_1 are positive, inventory holding has a positive impact on the price-cost margin when inventory is held to reduce the randomness in the demand curve and the firm is a risk averter.

Case 2 : When the firm is a risk taker.

Price-cost margin Z is defined as :

$$Z = 1 - \frac{AC}{P}$$

$$= 1 - \frac{a_0 + a_1 Y}{\alpha - \beta S + \lambda \sigma^2} \qquad \text{[from expressions (2.29) and (2.32)]}$$

$$= 1 - \frac{a_0 + a_1 Y}{\alpha - \beta S + \lambda \gamma_0 - \lambda \gamma_1 F} \qquad \text{[from expression (2.28)]} \qquad (2.38)$$

Again the relationship between the price-cost margin and inventory holding can be studied by differentiating Z with respect to F. That is,

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S + \lambda \gamma_0 - \lambda \gamma_1 F)\, a_1 + (a_0 + a_1 Y)\, \lambda \gamma_1}{(\alpha - \beta S + \lambda \gamma_0 - \lambda \gamma_1 F)^2} \qquad (2.39)$$

Expression (2.39) contains the impact of inventory holding on the price-cost margin under both reducing demand uncertainty motive (when the firm is a risk taker) as well as economies of scale motive. The impact of inventory holding on the price-cost margin under the economies of scale motive only (as can be seen from expression 2.19) is -

$$\frac{\partial Z}{\partial F} = - \frac{(\alpha - \beta S) a_1}{(\alpha - \beta S)^2} \qquad (2.40)$$

Thus, the effect of one unit change in inventory holding on the price-cost margin due to reducing demand uncertainty motive only and when the firm is a risk taker can be found out by subtracting expression (2.40) from expression (2.39). That is,

$$\left.\frac{\partial Z}{\partial F}\right]^{\text{D.U.\& R.T}} = - \frac{(a_0 + a_1 Y)\, \lambda \gamma_1}{P^2} \qquad (2.41)$$

where $\left.\frac{\partial Z}{\partial F}\right]^{\text{D.U.\& R.T}}$ is the effect of one unit change in inventory

holding on the price-cost margin due to reducing demand uncertainty motive when the firm is a risk taker.

Since in expression (2.41) both λ and γ_1 are positive, therefore, inventory has a negative impact on the price-cost margin when inventory is held to reduce demand uncertainty and the firm is a risk taker.

From expression (2.31) we see that σ^2 (i.e. variation in price) is not included in the demand function of a risk neutral firm. It is through σ^2 that inventory holding is putting an effect on the demand function. Therefore since σ^2 is not included in the demand function of a risk neutral firm, such a firm has no impact on the price-cost margin.

The next motive of inventory holding is that inventory is held to deter the entry of new firms. A firm which has a large enough inventory can temporarily reduce price to drive out an entrant. For, as Ware (1985) argued, the threat to sell off inventory at a lower price is real since the opportunity cost of inventory is zero if entry does occur. Thus, a sufficiently large stock of inventory will ensure a negative present value for the entrant, no matter how small the fixed cost of entry. Hence, entry can always be deterred effectively. This results in a reduction of the number of firms in the market. For a given total market demand the primary effect of this will also be a shift to the right of the demand curve for the firm (Rao, 1991). That is, large inventory holding by the firm increases its market power through shift in its demand curve and thus creating a barrier to

entry. The demand function for this motive is the same as it was under increase in demand motive. Thus, the theoretical model under entry deterrent motive is not being described separately.

2.5 INVENTORY AND SPECULATION

In the context of speculative motive, Kaldor (1939) defines speculation as the purchase (or sale) of goods with a view to resale (or repurchase) at a later date, where the motive behind such action is the expectation of a change in the relative prices. That is, there is gain only through change in relative prices and there is no gain accruing through their use, or any kind of transformation effected in them or their transfer between different markets. The above definition emphasizes that the only reason for purchase (or sale) is the expectation of an impending price change, therefore the ordinary transactions of dealers are explicitly excluded. Clearly speculative stocks are "the difference between the amount actually held and the amount that would be held, if other things being the same, the price of that thing were expected to remain unchanged" (Rowley and Trivedi, 1975, pp. 47). The difference can be negative or positive. The relevant expectations here are the expectations of the individual speculator which may or may not coincide with the general expectations. Speculative stockholding would be significant in the aggregate when the general expectation regarding prices depart considerably from the current price.

Inductive reasoning along the lines of Kaldor (1939) suggests that not all goods are equally likely objects of price

speculation. Indeed it is not hard to suggest several categories of manufacturing production where speculation can be ruled out on apriori reasoning. This has direct implications for econometric work with aggregate data.

Muth (1961) has considered the question of optimal speculation. Consider an individual who, in period t, has an opportunity of purchasing goods at a known price P_t for sale in period (t+1). Suppose that cost of transactions are negligible. Price in period (t+1) is unknown but he knows its probability distribution and uses its mean as the expected price P^e_{t+1} in that period. Let σ^2_{t+1} be the variance of this distribution. Let I^s_t represent the speculative inventory at the end of period t. Then the expected profit $E(\pi_t)$, or speculative gain is -

$$E(\pi_t) = I^s_t \ (P^e_{t+1} - P_t) \qquad (2.42)$$

Thus we see that a firm gains by holding inventory when prices are low and selling them off when prices rise. That is, a firm reduces sales in the current period and increases the stock of inventory in the expectation that this inventory can be disposed off in the future when the conditions will be favourable. There will be an increase in demand in the current period from the consumers side because they know that the prices will be high in the future.

Since speculative motive affects both price and cost, the relationship between the price-cost margin and inventory holdings can be studied under this motive also.

Let the demand function show that price in period t is an inverse function of volume of sales in period t and a direct function of the expected price in period (t+1). That is,

$$\text{Demand Function : } P_t = \alpha - \beta S_t + \mu P^e_{t+1}, \qquad \mu > 0 \tag{2.43}$$

Expression (2.43) shows that if the expected price in period (t+1) is higher, the demand curve in period t shifts to the right.

There also exists a relationship between inventory holdings at the end of period t and expected price in period (t+1). That is,

$$P^e_{t+1} = \theta_o + \theta_1 F_t, \qquad \theta_1 > 0 \tag{2.44}$$

Further let us assume that average cost is a function of output and inventory. That is,

$$AC = a_o + a_1 Y \tag{2.45}$$

When inventory is held to take speculative advantage in the future, a change in inventory is brought about only by changing volume of sales. That is, one unit increase (or decrease) in inventory means one unit decrease (or increase) in the volume of sales. That is,

$$\delta S = \delta F = -1 \tag{2.46}$$

We know that price-cost margin Z is defined as:

$$Z = 1 - \frac{AC}{P}$$

$$= 1 - \frac{a_o + a_1 Y}{\alpha - \beta S + \mu\theta_o + \mu\theta_1 F} \quad \text{[from expressions (2.43) (2.44) and (2.45)]}$$

(2.47)

The relationship between the price-cost margin and inventory holdings can be studied by differentiating Z with respect to F. That is,

$$\frac{\partial Z}{\partial F} = -\frac{-(a_o + a_1 Y)\ (\beta + \mu\theta_1)}{P^2}$$

$$= \frac{(a_o + a_1 Y)\ (\beta + \mu\theta_1)}{P^2} \qquad (2.48)$$

Since in expression (2.48) β, μ and θ_1 are positive, inventory holding has a positive impact on the price-cost margin when the inventory is held to take speculative advantage in the future.

To sum up, we see that finished product inventory has a positive impact on the price-cost margin under all the motives except when inventory is held to reduce the randomness in the demand curve and the firm is a risk taker.

In the following chapter we present the details of the data which will be needed for the empirical analysis conducted in Chapters 4 and 5.

CHAPTER 3

ESTIMATION METHODOLOGY AND DATA BASE OF THE STUDY

The theoretical derivations of the relationship between price-cost margin and inventory holding under different motives have been presented in the preceding chapter of this study. Our objective is to test these derivations empirically for selected Indian industries. In order to do this job, we need an estimation methodology and data. This chapter is devoted to these aspects of the study.

3.1 METHODOLOGY

To estimate the relationship between price-cost margin (i.e. profitability) and inventory holdings with different motives is a difficult task. The main problem in this context arises in quantification of the motives. Indirectly, however, the relationship can be estimated by using the simultaneous equation framework. An attempt in this direction has been made by Langlois (1989). The methodology of this study was adopted by us in derivation of the results of the relationship between price-cost margin and inventory holding under different motives as described in chapter 2. The elements of the methodology are essentially two equations : an average cost function and a demand function, each one of them having different set of explanatory variables, inventory being in both of them. The variables appearing in the

equations reflect the motives of inventory holdings. By substituting the expressions for price of product (i.e. demand function) and average cost in the price-cost margin which is defined as ($Z = \frac{P - AC}{P}$ as denoted in chapter 2) we get an explicit relationship between price-cost margin and inventory holdings. Direct estimation of this kind of reduced function creates difficulty because of its complex form. However, by taking the derivative of price-cost margin with respect to inventory holding (i.e. $\partial Z/\partial F$ as denoted in chapter 2) we can estimate the impact of inventory holding on profitability under different situations (i.e. under different motives for inventory holding). The derivatives (partial or otherwise) showing the changes in price-cost margins of the firms when their inventory holdings change by one unit will be a function of the parameters of the average cost function and of the demand function. With appropriate interpretation of the parameters and their signs we can identify the impact of unit change of inventory holdings on price-cost margins of the firms.

So, for the empirical analysis what we have to do is to estimate the average cost and demand functions for the firms and use the estimated parameters of these functions to find the impact of inventory holdings under different motives on price-cost margin (i.e. profitability) of the firms. As we have seen in chapter 2, this methodology enables us to isolate the impact of inventory holdings under different motives on the price-cost margin when the motives are in operation simultaneously. The

methodology is therefore, quite useful for the empirical analysis being carried out in this thesis.

We also intend to estimate a direct relationship between price-cost margin and inventory holdings. In this case we will be taking all the motives of inventory holdings together since all of them affect the inventory holdings which in turn affects the price-cost margin of the firm.

3.2 THE SAMPLE

Firm level data for a number of selected Indian industries is being used for this study. To ensure adequate representation of the firms, the following considerations were borne in mind in selection of the sample of the firms for the study.

(a) The firm must be a major producer in the industry concerned. In the modern world, most of the firms are multiproduct firms. Therefore, it is very difficult to categorise a firm into a particular product group or industry. To categorise different firms into different product groups, the following consideration was taken. If the contribution of the major product in total sales was more than 50 percent the firm was classified into that major product group or industry. If there was no product the contribution of which in total sales was more than 50 percent, the firm was classified as a diversified firm.

(b) The sample must, as far as possible, be representative of the industry.

(c) To ensure the quality of data, the sample must be restricted to the organised sector of the industry.

The sample of the firms represents only public limited companies of the organised sector. Such companies are large and medium units of the concerned industries. Both Indian and multinational firms are included in the sample of the firms for the study. By and large, in our opinion, the sample is fairly representative of the organised sector of Indian industries.

There was not much difficulty in categorising different firms into different industry groups. A look at the product structure of the firms initially considered, revealed that only in the case of approximately 10 percent firms, the contribution of the major product in total sales turnover of a particular firm was less than 50 percent. Such firms were classified as diversified firms and they have not been included in the sample considered for the purpose of this study. The remaining 90 percent of the firms were easily categorised into different product groups or industries as they had only one major product each, the contribution of which in total sales was more than 50 percent. Appendix 3A provides names of the firms in each product group/ industry taken for the study. The number of the firms considered for the study in each industry may be summarised as follows in Table 3.1.

3.3 THE DATA

This study is based on firm level time-series data covering the period 1979 to 1989. Consistent data beyond 1989 and before

TABLE 3.1

PRODUCT GROUP/INDUSTRY	NUMBER OF FIRMS
A. CONSUMER NON DURABLES	23
1. Food Product Industry	3
2. Vanaspati Industry	3
3. Tea Industry	5
4. Sugar Industry	3
5. Cigarette Industry	4
6. Beverages Industry	3
7. Drugs Industry	2
B. CONSUMER DURABLES	18
1. Cotton Textile Industry	7
2. Woollen Textile Industry	4
3. Man Made Fibre Industry	3
4. Leather, Leather Products and Footwear Industry	1
5. Motor Cycles, Scooters etc. Industry	3
C. PRODUCER NON DURABLES	24
1. Cement Industry	5
2. Paper Industry	6
3. Fertiliser Industry	4
4. Chemical Industry	5
5. Paint Industry	4
D. PRODUCER DURABLES	20
1. Aluminium Industry	2
2. Glass Industry	3
3. Iron and Steel Industry	8
4. Machinery Industry	7

1979 was not available for all the firms in the sample of study.

The basic data on production, sales, cost etc. was taken from the Stock Exchange Official Directory, Bombay (1990) supplemented by the alternative source - 'Key Data on Large Business Units' published by the Centre for Monitoring Indian Economy (CMIE), Bombay, 1990, for missing gaps and series of data for the firms. For example, data on finished product inventory which is the key explanatory variable of price-cost margin in this study was not available separately in the Stock Exchange Directory. This was taken from the CMIE publication.

Both the Stock Exchange Directory and the CMIE publication provide data on sales and inventory etc. in money terms. Since the estimation of demand and average cost functions required data on sales and inventory in physical terms, the conversion of data from money terms to physical terms was itself a problem. The Stock Exchange Official Directory provides the output data (in physical terms) for different years. For single product firms we did not face much problem in converting the data. In this situation, the data was converted into physical terms by using the following well known identity.

$$TC_M = CS_M + \Delta F_M \qquad (3.1)$$

where

TC_M : total cost of production in money terms.

CS_M : cost of goods sold in money terms.

ΔF : change in finished product inventory in money terms.

TC_M is defined as average cost multiplied by output produced in physical terms. Thus, the above identity (equation 3.1) can also be written as –

$$AC \times O_P = CS_M + \Delta F_M \qquad (3.2)$$

where

O_P : output in physical terms

AC : average cost.

Since the data on output in physical terms and cost of goods sold in money terms were available in the Stock Exchange Official Directory (1990) and the data on change in finished product inventory was available in the CMIE (1990) data source, the average cost was calculated in the following way :

$$AC = \frac{CS_M + \Delta F_M}{O_P} \qquad (3.3)$$

After calculating the average cost for different years, sales in physical terms and inventory in physical terms were calculated by using the following formulae:

$$S_p = \frac{CS_M}{AC} \text{ and} \qquad (3.4)$$

$$F_p = \frac{F_M}{AC} \qquad (3.5)$$

where

S_p : sales in physical terms

F_p : finished product inventory in physical terms.

Prices for different years were calculated as follows –

$$P = \frac{N.S}{S_P} \qquad (3.6)$$

where

P : price

N.S: Net sales in money terms.

Thus we have data on all the variables [that is, sales (S) in physical terms, finished product inventory (F) in physical terms, output (Y) in physical terms, price (P) and average cost (AC)] which are required to estimate the demand and average cost functions. In this way we computed the different variables for single product firms.

In the case of multiproduct firms the above procedure for computation of different variables could not be used because the profit and loss accounts and balance sheets available in the Stock Exchange Official Directory source and the CMIE source do not provide information about each product separately. These sources provide data on net sales, cost of goods sold etc. for the products together. Since the price and average cost of two products may be very much different, the above mentioned method was not used for computation of the variables of multiproduct firms for estimation of their demand and average cost functions.

An alternative method was used to compute the different variables for such firms. Market and Market Share Data, published by CMIE (1990) provided us data on sales both in physical terms and in money terms of different products produced by a firm. The variables in the case of multiproduct firms were calculated as follows –

Step 1 : Price of the major product (that is, that product the contribution of which in total sales is more than fifty percent) was computed by dividing net sales in money terms by net sales in physical terms. This price of the major product of the firm was used to estimate the demand function.

Step 2 : Sales in physical terms of all the products, was converted in terms of sales in physical terms of the major product. This was done by dividing net sales (of all the products taken together) in money terms by price of the major product (as computed in Step 1).

Step 3 : Average cost was computed by dividing cost of goods sold by sales in physical terms (as computed in Step 2).

Step 4 : Change in inventory in physical terms was computed by dividing the change in inventory in money terms by the average cost (as computed in Step 3).

Step 5 : Output in physical terms was computed by adding sales in physical terms (as computed in Step 2) and change in inventory in physical terms (as computed in Step 4).

Step 6 : Inventory at the end of the period in physical terms was computed by dividing inventory at the end of the period in money terms by the average cost (as computed in Step 3).

APPENDIX 3A

INDUSTRY-WISE LIST OF THE SAMPLE COMPANIES

A. FOOD PRODUCT INDUSTRY

1. Britannia Industries Ltd.
2. Milkfood Ltd.
3. Cadbury (India) Ltd.

B. VANASPATI INDUSTRY

1. The Modern Mills Ltd.
2. Tungabhadra Industries Ltd.
3. Amrit Banaspati Company Ltd.

C. TEA INDUSTRY

1. Assam Company (India) Ltd.
2. Assam Frontier Tea Ltd.
3. Dooma Dooma India Ltd.
4. Tata Tea Ltd.
5. Warren tea Ltd.

D. SUGAR INDUSTRY

1. Kesar Sugar Works Ltd.
2. Kothari Sugars & Chemicals Ltd.
3. Sri Chmundeswari Sugars Ltd.

E. CIGARETTE INDUSTRY

1. G.T.C. Ltd.
2. I.T.C. Ltd.
3. Godfrey Phillips Ltd.
4. V.S.T. Ltd.

F. BEVERAGES INDUSTRY

1. Arlem Beweries Ltd.
2. Jagatjit Industries Ltd.
3. Mohun Meakins Ltd.

G. DRUGS INDUSTRY

1. Alembic Chemical Works Ltd.
2. Glaxo India Ltd.

H. COTTON TEXTILES INDUSTRY

1. Ahmedabad Kaiser-Hind Mill Ltd.
2. Bharat Vijay Mills Ltd.
3. Lakshmi Mills Company Ltd.
4. Madura Coats Ltd.
5. Nutan Mills Ltd.
6. Lakshmi Vishnu Textile Mills Company Ltd.
7. Rohit Mills Ltd.

I. WOOLLEN TEXTILES INDUSTRY

1. L.D. Textile Industries Ltd.
2. Shri Dinesh Mills Ltd.
3. Reliance Industries Ltd.
4. Shri Rajasthan Syntex Ltd.

J. MAN MADE FIBRE INDUSTRY

1. Shree Synthetic Ltd.
2. National Rayons Corporation Ltd.
3. Indian Organic Chemicals Ltd.

K. LEATHER, LEATHER PRODUCTS AND FOOTWEAR INDUSTRY

1. Carona Ltd.

L. MOTOR CYCLES, SCOOTERS ETC. INDUSTRY

1. Bajaj Auto Ltd.
2. Maharastra Scooters Ltd.
3. Automobile Products of India Ltd.

M. CEMENT INDUSTRY

1 The Andhra Cement Company Ltd.
2. Dalmia Cement Ltd.
3. Mysore Cement Ltd.
4. Shree Digvijay Cement Company Ltd.
5. Madras Cement Ltd.

N. PAPER INDUSTRY

1. Balkrishna Industries Ltd.
2. The Mysore Paper Mills Ltd.
3. NEPA Ltd.
4. Seshasayee Paper & Board Ltd.
5. Star Paper Mills Ltd.
6. Ballarpur Industries Ltd.

O. FERTILISER INDUSTRY

1. The Dharamsi Morarji Chemical Company Ltd.
2. Excel Industries Ltd.
3. The Fertilisers & Chemical Travancore Ltd.
4. Gujarat State Fertiliser Company Ltd.

P. CHEMICAL INDUSTRY

1. Aegis Chemicals Ltd.
2. Citurgia Biochemicals Ltd.
3. Gujarat Alkalies & Chemicals Ltd.
4. Polyoefin Industries Ltd.

5. Deepak Nitrite Ltd.

Q. PAINT INDUSTRY

1. Garware Paints Ltd.
2. Goodlass Nerolac Paints Ltd.
3. Berger Paints Ltd.
4. Asian Paints Ltd.

R. ALUMINIUM INDUSTRY

1. Hindustan Aluminium Corporation Ltd.
2. Indian Aluminium Company Ltd.

S. GLASS INDUSTRY

1. Borosil Glass Works Ltd.
2. J.G. Glass Ltd.
3. Indo Asahi Glass Company Ltd.

T. IRON AND STEEL INDUSTRY

1. Bihar Alloy Steels Ltd.
2. Ferro Alloys Corporation Ltd.
3. Graham Firth Steel Products (India) Ltd.
4. K.E.C. International Ltd.
5. Mukund Ltd.
6. Rathi Alloys & Steels Ltd.
7. Steel Tubes of India Ltd.
8. Bharat Forge Ltd.

U. MACHINERY INDUSTRY

1. Atlas Copco (India) Ltd.
2. Kirloskar Cummins Ltd.
3. Kirloskar Pneumatic Company Ltd.
4. The Mysore Kirloskar Ltd.

5. Punjab Tractors Ltd.

6. Ruston & Hornsby (India) Ltd.

7. Kelvinator of India Ltd.

CHAPTER 4

EMPIRICAL FINDINGS

4.1 INTRODUCTION

This chapter deals with the estimation of the relationship between price-cost margin and inventory holdings under different motives for selected Indian industries by using the firm level data as envisaged in this thesis. The theoretical deductions of the models under investigation are given in Chapter 2 while Chapter 3 provides a discussion on the methodology of the study and its data base. The task of analysing the impact of inventory holding under all the five motives as listed earlier is quite cumbersome. A simplified version of the model adopted on the basis of the following arguments is being used for empirical investigation in this chapter.

In Chapter 2, while going through the reduced form equations of the demand functions under increase in demand motive, reduction in demand uncertainty motive and speculative motive, we observe that in all the three cases price is a function of the volume of sales and inventory. From Chapter 2 it is also observed that the average cost function remains the same for all the motives. That is, both the demand and the average cost functions are the same for all the three motives. Thus, if some inventory is held in the expectation that all the three motives will be satisfied simultaneously it means that the impact of inventory on price-

cost margin will be the same for all the three motives. If a firm is holding some inventory, it means that some part of it is being held to satisfy increase in demand motive, some part is being held to reduce demand uncertainty motive and some part of it is being held for speculative purposes. Thus, it is very difficult to separate out the effect of inventory on price-cost margin under these three motives unless we are given the information regarding how much inventory is held for each motive separately. Since such information is not known, it implies that the three impacts are incorporated in each other and it is not possible to separate them. Besides this, there are measurement problems also associated with demand uncertainty and speculative motives.

On account of the above problems the empirical analysis could not be conducted separately for each motive. On the other hand, we took recourse to the following -

The five motives were divided into two broad groups (i) one group consisting of motives which affect only the average cost function and (ii) the other group consisting of all motives which affect the demand function only. We know that economies of scale motive affects the average cost function and all other motives affect the demand function. Thus, the first category viz., the cost category incorporates the economies of scale motive while the second category viz., the demand category incorporates the remaining motives (i.e. increase in demand, demand uncertainty, entry deterrent and speculative motives).

In a simplified form, the purpose of empirical analysis now is to separate the variation in the price-cost margin due to two

categories of motives, that is the cost category and the demand category.

To investigate the relationship between the price-cost margin and inventory holding, a linear specification of the model is proposed. This is a quantitative analysis for which the econometrics technique is chosen. To find the impact of inventory holding on the price-cost margin under each broad category of motives, each factor which motivates the firm to hold inventory is incorporated in the demand and average cost functions separately under each category. The ordinary least square or two stage least square technique is applied to estimate the coefficients of demand and average cost functions under each category. The estimated demand and average cost functions under each category are substituted in the price-cost margin formula (which is equal to $\frac{P - AC}{P}$). We then get the price-cost margin as a function of inventory holding. The impact of inventory holding on the price-cost margin under each category is studied by differentiating price-cost margin (as computed under the two different categories) with respect to inventory holding. Thus, on the basis of this analysis it can be shown which category is better in terms of the performance of the firm as far as the relationship between price-cost margin and inventory holding is concerned.

4.2 SPECIFICATION OF THE MODEL

The main objective of this section is to specify the models to find out the impact of inventory holding on the price cost

margin under two categories of motives - the cost category and the demand category, at the firm level for different Indian industries.

4.2.1 COST CATEGORY

The first category of motives of inventory holding as described earlier is the cost category. This category incorporates the economies of scale motive of inventory holding and affects only the average cost function, but to find out the effect of inventory on the price-cost margin, the estimation of the demand function is also necessary.

Thus, to study the relationship between price-cost margin and inventory holding under the cost category of motives of inventory holding, the following functions are specified.

(a) Demand Function :

It is assumed that price is an inverse linear function of volume of sales, ceteris paribus. That is -

$$P = \alpha + \beta S + u \qquad (4.1)$$

where

P is the real price,

S is the volume of sales in physical terms and

u is the random disturbance term.

The variation in prices of commodities can be explained due to two reasons -

(i) due to general inflation that is prevailing in the economy.

(ii) due to market forces.

The demand function explains the variation in price due to market forces. That is, producers or consumers see the advantages or disadvantages that are accruing to them due to market forces in terms of real price. Thus, the demand function describes the relationship between real price and volume of sales, ceteris paribus. The way in which we computed current price and volume of sales in physical terms has already been described in Chapter 3. The real price of a commodity was computed by deflating current prices by an index of the general price level.

The ordinary least square is applied to estimate the parameters of the demand function and in this way the demand function is estimated.

(b) Average Cost Function :

It is assumed that average cost is a function of the level of production –

$$AC = a_0 + a_1 Y + u \qquad (4.2)$$

where

AC is the average cost of production after including inventory carrying cost in real terms.

Y is the production in physical terms

u is the random disturbance term.

Holding of inventory involves cost of producing it, storage costs, interest costs etc. It is assumed that inventory holding affects only average cost of producing it and storage cost. Other costs do not put any effect on average cost because they are assumed constant on an average basis and are included in a_0.

Chapter 2, under economies of scale motive a change in inventory is brought about only by changing production. That is –

$$\delta Y = \delta F = 1 \qquad (4.3)$$

By substituting the estimated coefficients of the demand and average cost functions into the price-cost margin formula and by assuming equation (4.3), the impact of inventory on price-cost margin was computed under the cost category. The mathematical derivation of this has already been described in Chapter 2. For the sake of clarity the value of $\partial Z/\partial F$ under the cost category is reproduced here –

$$\partial Z/\partial F = \frac{-a_1}{P} . \qquad (4.4)$$

By substituting the mean value of price (i.e. $\bar{P}$) for P in equation (4.4), the value of $\partial Z/\partial F$ was computed in terms of a constant real number. That is, we computed –

$$\frac{\partial Z}{\partial F} = \frac{-a_1}{\bar{P}} . \qquad (4.5)$$

4.2.2 DEMAND CATEGORY

Average cost function remains the same for all the motives under this category. Thus, it is not necessary to respecify the average cost function.

As described earlier, the reduced form equation of the demand function is the same for all the motives under the demand category. Thus, the impact of each motive of inventory holding (i.e. increase in demand, reduction in demand uncertainty and speculative motives) on price-cost margin under this category is

the same. Thus, here we are specifying the demand function which incorporates all the three motives under this category.

Now, in order to study the relationship between price-cost margin and inventory holding under the demand category, the following demand function is proposed -

$$P = \alpha + \beta S + \gamma F + u \qquad (4.6)$$

Average cost function remains the same as it was under the cost category. A change in inventory is brought about only by changing production. That is -

$$\delta Y = \delta F = 1$$

The way in which the impact of inventory on price-cost margin was computed under the demand category has already been described in Chapter 2. Again, for the sake of clarity, the value of $\frac{\partial Z}{\partial F}$ under the demand category is being reproduced here -

$$\frac{\partial Z}{\partial F} = \frac{\gamma AC}{P^2} \cdot \qquad (4.7)$$

By substituting $\overline{AC}$ for AC and $\overline{P}$ for P in equation (4.7) we get the computed value of $\partial Z/\partial F$ as -

$$\frac{\partial Z}{\partial F} = \frac{\gamma \overline{AC}}{\overline{P}^2} \qquad (4.8)$$

where $\overline{AC}$ is the mean value of average cost of production and $\overline{P}$ is the mean value of price.

4.3 EMPIRICAL RESULTS

The models specified in Section 4.2 were tested empirically for 21 Indian industries at the firm level. That is, the relationship between finished product inventory and price-cost margin was studied under two broad categories of motives of

inventory holding viz. the cost category (incorporating economies of scale motive) and the demand category (incorporating increase in demand motive, reduction in demand uncertainty motive and speculative motive of inventory holding). The empirical results under each of the two categories are described below.

The results describing the relationship between the price-cost margin and finished product inventory are presented in Table 4.1. The first 7 industries belong to the consumer non durable industry group, industry number 8 to 12 belong to the consumer durable group, industry number 13 to 17 belong to the producer non durable group and industry number 18 to 21 belong to the producer durable industry group.

The first industry under the consumer non durable group is the Food Product industry. A sample of 3 firms was taken to study this industry. From Table 4.1 it can be seen that inventory has a positive impact on the price-cost margin in the case of all the three firms in the sample both under the cost category and under the demand category. The contribution of the cost category is more in the case of one firm (Cadbury) and the contribution of the demand category is more in the case of the other two firms.

The results of the Vanaspati industry show that in a sample of three firms, inventory has a positive impact on the price-cost margin in the case of all the firms in the cost category and in the case of two firms in the demand category. The contribution of the demand category is more than the cost category in case of both the firms which have a positive contribution under demand category

(Tungabhadra and Amrit Banaspati Ltd.). There is one firm (i.e. Modern Mills Ltd.) whose contribution is negative under the demand category but positive under the cost category. In the case of this firm, the negative impact is larger than the positive impact. Thus, on the whole, the total effect shows a positive relationship between the price-cost margin and inventory in the case of two firms and negative in the case of one firm in the Vanaspati industry.

The regression results of the Tea industry show that in a sample of five firms, three firms have a positive impact on the price-cost margin under the cost category and again three firms have a positive impact under the demand category. There are two firms whose contribution is positive both under the demand category and the cost category (i.e. Dooma Dooma India Ltd. and Tata Tea) but in both these firms the demand contribution is greater than the cost contribution. In the case of the firm, Assam Co. India Ltd., the contribution of the cost category is negative while that of the demand category is positive but the negative impact of the former is larger than the positive impact of the latter in this firm. In the case of Warren Tea Ltd., we find that the reverse is true. That is, in this firm the cost impact is positive while the demand impact is negative but in this case the positive impact is larger than the negative impact. In the case of Assam Frontier Tea Ltd., inventory is linked negatively with price-cost margin both under the cost and demand categories. Overall, we see that inventory has a positive impact in the case of three firms and negative in the case of two firms

in this industry.

To study the Sugar industry, a sample of three firms was taken. The results show that price-cost margin varies positively with inventory holding only in the case of of one firm under both categories. In case of Kothari Sugars & Chemicals Ltd., the positive contribution of the demand category is more than the negative contribution of the cost category. On the other hand, in case of Kesar Sugar Works Ltd. the positive impact of the cost category is less than the negative impact of the demand category. In case of the remaining one firm both impacts are negative, that of cost category being larger than that of demand category. The total effect shows a positive contribution of inventory on price-cost margin only in case of one firm in the Sugar industry.

Coming next to the Cigarette industry, we see that in a sample of four firms, the contribution of the cost category is positive in case of three firms while the contribution of the demand category is positive in case of two firms. In case of two leading firms of this industry group viz., Godfrey Phillips Ltd. and ITC Ltd., the contribution of both categories is positive, that of demand being larger than that of cost in both these firms. In case of GTC, the negative contribution of the demand category is greater than the positive impact of the cost category. In case of VST Ltd., both impacts are negative. Overall, the results show that inventory is linked positively with price-cost margin in the case of two firms in this industry.

The results of Beverages industry and Drugs industry are quite similar. All the firms considered under both industries show a positive overall impact as well as a positive impact under both the cost and the demand categories.

Thus, taking the non durable consumer industry group as a whole, the results show that out of 23 firms considered, as many as 18 firms show a positive impact under the cost category while as many as 16 firms show a positive impact under the demand category. The overall effect is also positive in the case of 16 firms in this industry group. This indicates that there is excess capacity in the firms belonging to this industry group as a result of which economies of scale are operating here. The reason for a large number of firms showing a positive impact under demand category is that consumer non durable products are a necessity and demand is positively affected by product availability.

Next, industries under consumer durable group were considered. The first industry considered under this group was the Cotton Textile industry. The results show that in a sample of seven firms the contribution of cost category is positive in case of six firms while the contribution of demand category is positive only in case of one firm. The negative contribution of demand is greater than the positive contribution of cost in case of most of the firms. The total impact is negative in case of six firms and positive in case of only one firm.

In the Woollen Textile industry the results show that in a sample of four firms the contribution of cost category is positive

in the case of two firms while that of demand category is positive in the case of one firm only. In case of L.D. Textile Industry Ltd., the contribution of both the cost category and the demand category is negative. In case of Dinesh Mills Ltd. both the impacts are positive while in case of Reliance Industries Ltd., the negative contribution of demand category is more than the positive contribution of cost category. The total effect shows that inventory has a positive impact on price-cost margin in case of only one firm.

The next industry taken under consumer durable group is Man Made Fibre Industry. The results show that in a sample of three firms, the cost impact is positive in case of all the firms in the sample, while the demand impact is positive in case of two firms. In case of two firms the contributions of both demand and cost motives are positive but the contribution of demand motive is more. In the case of National Rayons Corporation Ltd., the positive contribution of cost motive is more than the negative contribution of demand motive. The total effect shows that inventory is linked positively with price-cost margin in case of all the firms.

Due to small organised sector in the Footwear industry, only one firm could be studied. The results for this firm show a negative contribution of the demand motive and positive contribution of the cost motive. The total effect comes out to be negative for the firm.

The results of the Two Wheeler industry show that in a sample of three firms, the contribution of the cost category is positive in the case of two firms, while the contribution of the demand category is positive in the case of one firm. In case of one firm (Maharashtra Scooters Ltd.) both impacts are positive while in case of Bajaj Auto Ltd. both impacts are negative. The total effect shows that price-cost margin varies positively with inventory in case of only one firm.

To sum up, it can be said that in the consumer durable product group most of the firms are experiencing economies of scale in their production process and thus the impact of cost motive on price-cost margin is positive in most of the firms under this group. On the other hand, the adverse impact of demand motive on price-cost margin shows that except in the case of the firms of Man Made Fibre industry, most of the firms are holding unintended inventory. This shows that there is a recessionary situation in the industries belonging to this product group. In most of the firms the negative impact of the demand motive is higher than the positive impact of the cost motive as a result of which the total effect is negative for most of the firms belonging to this industry group.

The next broad industry group considered for empirical analysis is the producer non durable group. The first industry considered in this group is the Cement industry. The results of this industry show that in a sample of five firms the contribution of the cost motive is positive in the case of three firms while

the contribution of the demand motive is positive in the case of only one firm. In case of three firms the negative contribution of the demand category is more than the positive contribution of the cost category. In case of one firm (Shri Digvijay Cement Co. Ltd.) the positive contribution of the demand category is more than the negative contribution of the cost category. In case of Andhra Cement Co. Ltd. both the impacts are negative. The overall impact shows that inventory has a negative impact on the price-cost margin in case of all the firms except Shri Digvijay Cement Co. Ltd.

The results of the Paper industry show that in a sample of six firms as many as five firms have a positive impact under the cost category and the same five firms have a negative impact under the demand category. Only in Star Paper Mills Ltd. we see the reverse, that is, there is a negative impact under the cost category and a positive impact under the demand category. In case of four firms we see that the overall impact is negative. For three of these four firms the overall negative impact is due to the negative demand impact being more than the positive cost impact while in the case of one firm (Star Paper Mills Ltd.) the overall negative impact is due to the negative cost impact being more the positive demand impact. In case of two firms only, the overall impact is positive which is due to the positive cost impact being more than the negative demand impact.

Coming next to the Fertiliser industry, it can be observed that in a sample of four firms, all firms show a positive impact under the cost category while only two firms show a positive

impact under the demand category. The overall impact is positive in three firms. Out of these three firms, the overall impact of two firms is positive due to both cost and demand impacts being positive while the overall impact of one firm (Dharamsi Morarji Chemical Co. Ltd.) is positive due to the positive impact of the cost category being more than the negative impact of the demand category.

In the Chemical industry a sample of five firms was taken. The results show that in the case of two firms the cost impact is positive while in the case of four firms the demand impact is positive. The overall results show that inventory has a positive impact on the price-cost margin in case of three firms. Out of these three firms the total impact is positive in two firms because both impacts are positive while in one firm (Deepak Nitrides Ltd.) the total impact is positive because the positive demand impact is larger than the negative cost impact. In two firms the total impact is negative, in one firm this is due to both impacts being negative while in the other this is due to a larger negative cost impact and a smaller positive demand impact.

The last industry considered in the producer non durable group was the Paint industry. The results show that in a sample of four firms, the demand impact is positive in all firms except Garware Paints Ltd. while the cost impact is positive in case of three firms. The overall impact of three firms is positive, while that of Garware Paints Ltd. is negative.

Considering the producer non durable group as a whole, we find that except in a few cases the cost impact is positive for most of the firms implying that there is excess capacity in this industry group and inventories are being held to take advantage of economies of scale. On the other hand, there is no clear cut trend visible under demand impact. In case of Cement and Paper industries the demand impact is mostly negative, while in the case of Chemical and Paint industries this impact is mostly positive. This means that inventory is not valued positively from the user side in Cement and Paper industries while in case of Chemical and Paint industries the user responds positively to availability.

The last industry group studied was the producer durable product group. The first industry under this industry group is Aluminium industry. The results for this industry show that in a sample of two firms, the cost impact is positive in one firm while in both firms the demand impact is negative. The overall impact in both firms is negative.

In the Glass industry the results show that in a sample of three firms, the cost, demand and overall impacts are positive for all firms. For all firms the demand impact is larger than the cost impact.

In the Iron and Steel industry a sample of eight firms was considered. The results show that the cost impact is negative is five firms, the demand impact is negative in four firms and the overall impact is negative in five firms. In the case of two firms (Bihar Alloy Steels Ltd. and K.E.C. International Ltd.) the

overall negative impact is due to the adverse demand impact being more than the favourable cost impact. On the other hand, in Ferro Alloys Corporation Ltd. and Mukund Ltd. the overall negative impact is due to the negative cost impact being slightly greater than the positive demand impact. In case of Graham Firth Steel Product India Ltd. the overall negative impact is due to both impacts being negative. The overall impact of three firms is positive. In two firms this is due to the positive demand impact being more than the negative cost impact while in one firm (Bharat Forge Ltd.) this is due to the positive cost impact being more than the negative demand impact.

The last industry under study is the Machinery industry. In this industry out of a sample of seven firms, four firms show a positive cost impact while only two firms show a positive demand impact. The overall impact is negative in five firms, in three firms this is due to both impacts being negative while in two firms this is due to the negative demand impact being more than the positive cost impact. In case of two firms the overall impact is postive, this is due to both impacts being positive.

Taking the producer durable product industry group as a whole we find that except in the case of Glass industry, the relationship under both categories is not consistent. In the Glass industry inventory is held to enjoy economies of scale as well as to attract customers by providing regular supply of product. In the other industries there is variation from firm to firm and thus no clear trend is visible in these industries.

4.4 SUMMARY

In this chapter we studied empirically the variation in the price-cost margin due to cost motive and demand motive of inventory holding.

The industries were divided into four broad categories namely consumer non durables, consumer durables, producer non durables and producer durables.

The results showed that the cost impact is positive in most firms except in a few firms of the producer durable product group indicating the existence of economies of scale. The demand impact is mostly positive for the consumer non durable group indicating that consumers respond to availability and there is favourable valuation of a firm's product by them. In the consumer durable industry group the demand impact is mostly negative indicating that most of the firms under this industry group are holding unintended inventory from the consumer point of view. This might be due to a recessionary situation prevailing in most of the industries under this industry group. In the producer non durable product group the demand impact is mostly positive in Paint and Chemical industries while it is mostly negative in case of Cement and Paper industries. There is no clear cut trend of the demand impact visible in this industry group. In the producer durable product group the impact of the demand category is again not clear. This implies an effective inventory management policy in some firms and the reverse in other firms of different industries of this group. Thus, in this group inventory management plays an

important role and is a must to reduce any unintended accumulation of inventory. Lastly, it was observed that in most firms of all four industry groups if one impact was negative the other impact was found to be positive. The cost impact in most cases was positive. This implies that inventory is held by most firms to satisfy at least one motive of inventory holding discussed earlier.

In the next chapter we examine the empirical relationship between inventory holding and price-cost margin directly without considering the cost motive and demand motive separately.

Note: The estimated demand and average cost functions under the cost category and the demand category at the firm level are shown in Appendix 4A and 4B, respectively.

Table 4.1

VARIATION IN PRICE-COST MARGIN DUE TO INVENTORY HOLDING ATTRIBUTED TO THE COST FACTOR AND THE DEMAND FACTOR

Name of Industry and Firm	Variation in Price-Cost Margin Due To		Total Effect
	Cost Category	Demand Category	
1. FOOD PRODUCT INDUSTRY			
Britannia Inds. Ltd.	0.0008924	0.0184336	0.019326
Milkfood Ltd.	0.0042014	0.0160216	0.020223
Cadbury India Ltd.	0.0277406	0.0149536	0.0426942
2. VANASPATI INDUSTRY			
The Modern Mills Ltd.	0.017134	-0.0722432	-0.0551092
Tungabhadra	0.008951098	0.0243029	0.033254
Amrit Banaspati Ltd.	5.537×10^{-3}	0.0433364	0.0488734
3. TEA INDUSTRY			
Assam Co. India Ltd.	-1.952×10^{-8}	5.769×10^{-9}	-1.375×10^{-8}
Assam Frontier Tea Ltd.	-1.213×10^{-8}	-3.170×10^{-7}	-3.291×10^{-7}
Dooma Dooma India Ltd.	1.826×10^{-8}	2.767×10^{-7}	2.945×10^{-7}
Tata Tea Ltd.	5.242×10^{-10}	1.678×10^{-8}	1.730×10^{-8}
Warren Tea Ltd.	3.527×10^{-8}	-2.800×10^{-8}	7.27×10^{-9}
4. SUGAR INDUSTRY			
Kesar Sugar Works Ltd.	1.266×10^{-6}	-8.382×10^{-6}	-7.116×10^{-6}
Kothari Sugars & Chemicals Ltd.	-3.252×10^{-6}	6.301×10^{-6}	3.049×10^{-6}
Sri Chumundeswari Sugars Ltd.	-5.97×10^{-7}	-1.695×10^{-7}	-7.665×10^{-7}

Table 4.1 (Contd.)

VARIATION IN PRICE-COST MARGIN DUE TO INVENTORY HOLDING ATTRIBUTED TO THE COST FACTOR AND THE DEMAND FACTOR

Name of Industry and Firm	Variation in Price-Cost Margin Due To		Total Effect
	Cost Category	Demand Category	
5. CIGARETTE INDUSTRY			
GCT Ltd.	1.944×10^{-8}	-5.178×10^{-7}	-4.984×10^{-7}
ITC Ltd.	3.447×10^{-9}	1.310×10^{-7}	1.344×10^{-7}
Godfrey Phillips Ltd.	7.920×10^{-9}	1.307×10^{-6}	1.315×10^{-6}
VST Ltd.	-5.751×10^{-5}	-5.052×10^{-6}	-6.256×10^{-5}
6. BEVERAGES INDUSTRY			
Arlem Beweries Ltd.	2.766×10^{-5}	2.272×10^{-4}	2.549×10^{-4}
Jagatjit Industries Ltd.	7.616×10^{-6}	1.807×10^{-6}	9.423×10^{-6}
Mohun Meakins Ltd.	2.748×10^{-5}	9.727×10^{-6}	3.721×10^{-5}
7. DRUGS INDUSTRY			
Alembic Chemical Works Ltd.	1.727×10^{-6}	1.159×10^{-6}	2.886×10^{-6}
Glaxo India Ltd.	2.387×10^{-8}	3.056×10^{-8}	5.443×10^{-8}
8. COTTON TEXTILE INDUSTRY			
Ahmedabad Kaiser Hind Mill	-6.285×10^{-4}	-4.100×10^{-5}	-6.695×10^{-4}
Bharat Vijay Mill Ltd.	5.869×10^{-6}	1.456×10^{-5}	2.043×10^{-5}
Lakshmi Mill Co. Ltd.	0.0247239	-0.0376645	-0.0129406
Madura Coats Ltd.	7.845×10^{-7}	-1.023×10^{-6}	-2.385×10^{-7}
Nutan Mills Ltd.	8.497×10^{-7}	-4.629×10^{-5}	-4.544×10^{-5}
Lakshmi Vishnu Textile Mills Co. Ltd.	1.380×10^{-5}	-2.867×10^{-5}	-1.487×10^{-5}
Rohit Mills Ltd.	1.119×10^{-5}	-1.202×10^{-4}	-1.090×10^{-4}

Table 4.1 (Contd.)

VARIATION IN PRICE-COST MARGIN DUE TO INVENTORY HOLDING ATTRIBUTED TO THE COST FACTOR AND THE DEMAND FACTOR

Name of Industry and Firm	Variation in Price-Cost Margin Due To		Total Effect
	Cost Category	Demand Category	
9. WOOLLEN TEXTILES INDUSTRY			
LD Textile Inds. Ltd.	-0.0838572	-0.1955066	-0.2793638
Shri Dinesh Mills Ltd.	2.525×10^{-4}	1.842×10^{-4}	4.367×10^{-4}
Reliance Ind. Ltd.	3.028×10^{-3}	-0.0218844	-0.0188564
Shri Rajasthan Syntex Ltd.	-0.072	-0.2774815	-0.3494815
10. MAN MADE FIBRE INDUSTRY			
Shree Synthetic Ltd.	0.0184542	0.0882206	0.1066748
National Rayons Corporation Ltd.	0.0926866	-0.0222686	0.070418
Indian Organic Chemicals Ltd.	0.0195992	0.121049	0.1406482
11. LEATHER, LEATHER PRODUCT & FOOTWEAR INDUSTRY			
Carona Ltd.	1.939×10^{-5}	-2.270×10^{-5}	-3.31×10^{-6}
12. MOTOR CYCLES, SCOOTERS ETC. INDUSTRY			
Bajaj Auto Ltd.	-2.146×10^{-6}	-1.888×10^{-3}	-1.890×10^{-3}
Maharashtra Scooters Ltd.	6.561×10^{-4}	0.0146997	0.0153558
Automobile Products of India Ltd.	0.0285177	-0.1308303	-0.1023126

Table 4.1 (Contd.)

VARIATION IN PRICE-COST MARGIN DUE TO INVENTORY HOLDING ATTRIBUTED TO THE COST FACTOR AND THE DEMAND FACTOR

Name of Industry and Firm	Variation in Price-Cost Margin Due To		Total Effect
	Cost Category	Demand Category	
13. CEMENT INDUSTRY			
The Andhra Cement Co. Ltd.	-4.079×10^{-4}	-9.806×10^{-5}	$-5.0596\times10^{-}$
Dalmia Cement Ltd.	6.202×10^{-4}	-3.739×10^{-3}	$-3.1188\times10^{-}$
Mysore Cement Ltd.	4.700×10^{-5}	-1.091×10^{-3}	-1.044×10^{-3}
Shri Digvijay Cement Co. Ltd.	-2.770×10^{-4}	2.395×10^{-3}	2.118×10^{-3}
Madras Cement Ltd.	1.263×10^{-4}	-2.982×10^{-4}	-1.719×10^{-4}
14. PAPER INDUSTRY			
Balkrishna Inds. Ltd.	2.062×10^{-3}	-0.0477088	-0.0456468
The Mysore Paper Mills Ltd.	8.144×10^{-4}	-6.434×10^{-4}	1.71×10^{-4}
NEPA Ltd.	4.682×10^{-4}	-7.258×10^{-3}	-6.790×10^{-3}
Sheshasayee Paper & Board Ltd.	3.358×10^{-3}	-1.054×10^{-3}	2.304×10^{-3}
Star Paper Mills Ltd.	-4.968×10^{-3}	2.055×10^{-3}	-2.913×10^{-3}
Ballarpur Inds. Ltd.	2.993×10^{-3}	-0.0138969	-0.0109039
15. FERTILISER INDUSTRY			
The Dharamsi Morarji Chemical Co. Ltd.	6.334×10^{-4}	-6.267×10^{-4}	6.7×10^{-6}
Excel Industries Ltd.	0.083376	-0.6148385	-0.5314625
Fertiliser & Chemical Travancore Ltd.	2.757×10^{-4}	5.387×10^{-4}	8.144×10^{-4}
Gujarat State Fertiliser Co. Ltd.	1.769×10^{-4}	1.567×10^{-3}	1.744×10^{-3}

Table 4.1 (Contd.)

VARIATION IN PRICE-COST MARGIN DUE TO INVENTORY HOLDING ATTRIBUTED TO THE COST FACTOR AND THE DEMAND FACTOR

Name of Industry and Firm	Variation in Price-Cost Margin Due To		Total Effect
	Cost Category	Demand Category	
16. CHEMICAL INDUSTRY			
Aegis Chemicals Ltd.	3.837×10^{-3}	0.0382366	0.0420736
Citurgia Biochemicals Ltd.	-2.281×10^{-3}	1.865×10^{-3}	-4.16×10^{-4}
Gujarat Alkalis & Chemicals Ltd.	-1.034×10^{-3}	-6.178×10^{-3}	-7.212×10^{-3}
Polyoefin Inds. Ltd.	2.317×10^{-3}	2.494×10^{-3}	4.811×10^{-3}
Deepak Nitrides Ltd.	-8.353×10^{-5}	2.060×10^{-3}	1.976×10^{-3}
17. PAINT INDUSTRY			
Jarware Paints Ltd.	0.012185	-0.021360	-0.009176
Goodlass & Nerolac Paints Ltd.	4.408×10^{-3}	3.874×10^{-3}	8.282×10^{-3}
Berger Paints Ltd.	6.916×10^{-3}	4.283×10^{-3}	11.199×10^{-3}
Asian Paints Ltd.	-3.327×10^{-6}	1.165×10^{-3}	1.162×10^{-3}
18. ALUMINIUM INDUSTRY			
Hindustan Aluminium Corporation Ltd.	-5.702×10^{-6}	-0.0305793	-0.030585
Indian Aluminium Co. Ltd.	3.679×10^{-3}	-4.635×10^{-3}	-9.56×10^{-4}
19. GLASS INDUSTRY			
Borosil Glass Works Ltd.	0.0457945	0.0822322	0.1280267
AG Glass Ltd.	4.156×10^{-3}	0.049696	0.053852
Indoashi Glass Co. Ltd.	4.208×10^{-5}	5.871×10^{-5}	1.0079×10^{-4}

Table 4.1 (Contd.)

VARIATION IN PRICE-COST MARGIN DUE TO INVENTORY HOLDING ATTRIBUTED TO THE COST FACTOR AND THE DEMAND FACTOR

Name of Industry and Firm	Variation in Price-Cost Margin Due To		Total Effect
	Cost Category	Demand Category	
20. IRON & STEEL INDUSTRY			
Bihar Alloy Steels Ltd.	3.996×10^{-3}	-0.0213097	-0.0173137
Ferro Alloys Corpn. Ltd.	-8.288×10^{-3}	8.13×10^{-3}	-1.58×10^{-4}
Graham Firth Steel Product India Ltd.	-0.02023919	-0.1349204	-0.1551596
KEC International Ltd.	1.691×10^{-3}	-0.0247413	-0.0230503
Mukund Ltd.	-5.996×10^{-4}	5.412×10^{-4}	-5.84×10^{-5}
Rathi Alloys & Steels Ltd.	-6.567×10^{-3}	0.0325787	0.0260117
Steel Tubes of India Ltd.	-9.254×10^{-3}	0.0481645	0.0389105
Bharat Forge Ltd.	0.1771681	-0.0394421	0.137726
21. MACHINERY INDUSTRY			
Atlas Copco India Ltd.	-0.0580222	-0.0361554	-0.0941776
Kirloskar Cummins Ltd.	5.291×10^{-3}	-0.0245128	-0.0192218
Kirloskar Pneumatic Co. Ltd.	4.571×10^{-4}	8.332×10^{-4}	1.2903×10^{-3}
The Mysore Kirloskar Ltd.	0.062134	0.037408	0.099542
Punjab Tractors Ltd.	-4.114×10^{-3}	-5.856×10^{-3}	-9.97×10^{-3}
Ruston & Hornsby (India) Ltd.	0.0459904	-0.0568985	-0.0109081
Kelvinator India Ltd.	-1.719×10^{-4}	-4.889×10^{-4}	-6.608×10^{-4}

Note: The low value of the total effect coefficients in some cases is due to the small unit of sales (in physical terms), finished product inventory (in physical terms) and production (also in physical terms). The significance of these coefficients should not be judged on the basis of low value of coefficients.

APPENDIX 4A
REGRESSION RESULTS : COST CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S$			Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
1.FOOD PRODUCT INDUSTRY						
Britannia Ind. Ltd.	12269.67	-13.47 (1.5414)	0.52	10586.05	-11.175 (1.147)	0.33
Milkfood Ltd.	15814.46	-41.532 (0.691)	0.36	15025.61	-70.4386 (1.5562)	0.26
Cadbury India Ltd.	61872.00	-1523.18 (4.1587)	0.68	46959.78	-1351.29 (4.5239)	0.72
2.VANASPATI INDUSTRY						
The Modern Mills Ltd.	12983.97	-134.399 (2.864)	0.51	13510.75	-186.927 (3.7045)	0.63
Tungabhadra	14588.29	-47.9354 (1.3037)	0.18	16643.58	-115.59 (3.8389)	0.65
Amrit Banaspati Ltd.	15565.59	-79.19 (5.2758)	0.85	14172.96	-70.82 (3.753)	0.78
3.TEA INDUSTRY						
Assam Co. India Ltd.	29.07	-0.001 (1.0)	0.09	6.86	0.0004 (2.0)	0.32
Assam Frontier Tea Ltd.	10.38	-0.0004 (1.0)	0.10	9.6	0.0002 (2.0)	0.15
Dooma Dooma India Ltd.	31.21	-0.002 (2.0)	0.25	12.52	-0.0003 (1.0345)	0.12
Tata Tea Ltd.	23.69	-0.00014 (0.9333)	0.16	15.38	-0.00001 (0.20)	0.01
Warren Tea Ltd.	28.15	-0.00072 (3.60)	0.56	17.24	-0.0005 (5.0)	0.66
4.SUGAR INDUSTRY						
Kesar Sugar Works Ltd.	3.37	-0.000007 (1.167)	0.10	2.79	-0.000004 (1.0)	0.08
Kothari Sugars & Chem. Ltd.	4.30	-0.000007 (0.70)	0.31	2.86	0.000012 (0.8571)	0.08
Sri Chmundeswari Sugars Ltd	3.38	-0.000003 (1.0)	0.09	2.42	0.000002 (0.40)	0.03
5.CIGARETTE INDUSTRY						
G.T.C. Ltd.	0.16	-2.9E-9 (1.5263)	0.23	0.15	2.6E-9 (1.1818)	0.15
I.T.C. Ltd.	0.16	-5.0E-10 (0.8333)	0.71	0.13	6.0E-10 (1.2)	0.13
Godfrey Phillips Ltd.	0.13	-5.0E-10 (0.2941)	0.68	0.14	1.2E-9 (1.7143)	0.26
V.S.T. Ltd.	206.35	-0.0072 (1.3153)	0.18	186.33	-0.00611 (1.222)	0.16
6.BEVERAGES INDUSTRY						
Arlem Beweries Ltd.	7.34	-0.00019 (1.3571)	0.21	6.40	-0.00018 (2.1429)	0.38
Jagatjit Ind. Ltd.	24.77	-0.00023 (1.5333)	0.31	18.15	-0.00018 (1.3846)	0.27
Mohun Meakins Ltd.	53.15	-0.00093 (6.5035)	0.88	44.59	-0.00078 (6.50)	0.87

APPENDIX 4A (Contd.)
REGRESSION RESULTS : COST CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S$			Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept Coefft. (α)	(β)	R^2	Intercept Coefft. (a_0)	(a_1)	R^2
7.DRUGS INDUSTRY						
Alembic Chemical Works Ltd	2.56	-0.000003 (2.8182)	0.30	2.05	-0.000003 (2.2667)	0.56
Glaxo India Ltd.	0.17	-2.9E-9 (2.2308)	0.39	0.14	-3.5E-9 (2.1875)	0.37
8.COTTON TEXTILES INDUSTRY						
Ahmedabad Kaiser Hind Mill Ltd.	6.31	-0.00009 (2.8125)	0.51	-47.8051	0.002836 (3.1616)	0.56
Bharat Vijay Mill Ltd.	14.489	-0.00007 (2.1212)	0.40	9.4530	-0.00007 (1.6279)	0.43
Lakshmi Mill Co. Ltd.	57823.24	-1583.31 (4.0808)	0.68	45047.79	-959.403 (3.3553)	0.58
Madura Coats Ltd.	5.5945	-0.000005 (5.0)	0.73	4.2062	-0.000003 (3.0006)	0.45
Nutan Mills Ltd.	13.95	-0.00024 (3.5294)	0.61	10.254	-0.00008 (1.7391)	0.32
Lakshmi Vishnu Textile Mill Co. Ltd.	8.6072	-0.00001 (0.2041)	0.01	12.4337	-0.00011 (4.583)	0.74
Rohit Mills Ltd.	12.7016	-0.00012 (1.3793)	0.22	11.9214	-0.00011 (2.0755)	0.35
9.WOOLLEN TEXTILES INDUSTRY						
L.D. Textile Ind. Ltd.	54657.96	-3210.22 (0.8078)	0.08	34297.69	4241.527 (0.7414)	0.08
Shri Dinesh Mills Ltd.	110.42	-0.01 (5.0)	0.82	93.64	-0.02 (10.0)	0.91
Reliance Ind. Ltd.	108849.2	-319.96 (2.8054)	0.50	88078.0	-289.7 (2.6368)	0.46
Shri Rajasthan Syntex Ltd.	67474.69	-994.318 (0.3436)	0.83	46787.91	3887.87 (0.8884)	0.10
10.MAN MADE FIBRE INDUSTRY						
Shree Synthetic Ltd.	95002.68	-2996.5 (4.1899)	0.76	75891.27	-1623.52 (2.9819)	0.77
National Rayons Corporation Ltd.	39822.61	-40.489 (0.2739)	0.17	114617.7	-3809.49 (6.459)	0.84
Indian Organic Chemicals Ltd.	72600.89	-629.337 (0.644)	0.20	68929.72	-1406.54 (2.0759)	0.51
11.LEATHER & FOOTWEAR INDUSTRY						
Carona Ltd.	20.94	-0.00035 (2.7778)	0.50	17.46	-0.0003 (3.6585)	0.62
12.TWO WHEELER INDUSTRY						
Bajaj Auto Ltd.	5060.84	-0.31 (1.2917)	0.17	4001.23	0.01 (0.0435)	0.0003
Maharashtra Scooters Ltd.	6034.45	-3.26 (1.203)	0.15	5532.38	-3.83 (1.0079)	0.11
Automobile Products of India Ltd.	16917.81	-276.37 (3.5072)	0.61	15452.77	-253.11 (5.0632)	0.76

APPENDIX 4A (Contd.)
REGRESSION RESULTS : COST CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S$			Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
13.CEMENT INDUSTRY						
The Andhra Cement Co. Ltd.	244.39	-0.35 (3.1818)	0.54	194.14	0.18 (2.25)	0.43
Dalmia Cement Ltd.	946.44	-0.35 (1.5217)	0.22	865.2	-0.44 (2.0952)	0.36
Mysore Cement Ltd.	686.74	-0.06 (1.0)	0.12	506.61	-0.03 (0.6)	0.06
Shri Digvijay Cement Co. Ltd.	645.93	-0.04 (0.5)	0.04	289.22	0.16 (1.333)	0.23
Madras Cement Ltd.	508.91	-0.25 (2.2727)	0.53	411.06	-0.07 (1.0)	0.10
14.PAPER INDUSTRY						
Balkrishna Ind. Ltd.	6425.97	-7.02 (0.6567)	0.05	5442.083	-13.02 (0.9617)	0.10
The Mysore Paper Mills Ltd.	6626.53	-1.21 (0.7423)	0.06	6086.43	-5.33 (2.9286)	0.52
NEPA Ltd.	5702.76	-5.16 (1.0840)	0.13	4887.82	-2.54 (0.4448)	0.03
Sheshasayee Paper & Board Ltd.	7855.831	-16.54 (0.9707)	0.11	7023.95	-23.5 (0.6763)	0.05
Star Paper Mills Ltd.	7806.5	-22.22 (1.0897)	0.13	5297.96	34.79 (1.019)	0.11
Ballarpur Ind. Ltd.	10398.71	-6.70 (0.8839)	0.28	4451.93	-27.29 (0.5532)	0.04
15.FERTILISER INDUSTRY						
The Dharamsi Morarji Chemical Co. Ltd.	1263.31	-0.55 (3.0556)	0.55	1184.1	-0.63 (2.8636)	0.49
Excel Ind. Ltd.	223191	-19144.1 (2.896)	0.51	167666.2	-15983.5 (2.6866)	0.47
Fertiliser & Chemical Travancore Ltd.	2481.35	-0.62 (6.2)	0.83	2094.96	-0.53 (3.5333)	0.60
Gujarat State Fertiliser Co. Ltd.	4324.213	-1.20 (3.6364)	0.62	3247.11	-0.64 (2.56)	0.45
16.CHEMICAL INDUSTRY						
Aegis Chemicals Ltd.	15383.78	-41.37 (0.4501)	0.03	12203.34	-62.25 (0.4514)	0.03
Citurgia Biochemicals Ltd.	3004.96	-5.29 (10.3725)	0.94	1491.71	6.38 (2.786)	0.52
Gujarat Alkalies & Chemical Ltd.	3520.43	-2.05 (4.1837)	0.68	1944.70	3.41 (2.2288)	0.38
Polyoefin Ind. Ltd.	19428.05	-30.38 (3.8456)	0.65	16511.05	-41.81 (2.7009)	0.48
Deepak Nitrides Ltd.	1054.72	-1.05 (4.375)	0.70	1054.72	0.12 (0.3529)	0.02
17.PAINT INDUSTRY						
Garware Paints Ltd.	27104.40	-485.876 (4.3019)	0.94	21410.49	-419.013 (2.9916)	0.70
Goodlass & Nerolac Paints Ltd.	26051.52	-134.272 (1.169)	0.80	20576.68	-121.48 (1.6744)	0.89
Berger Paints Ltd.	18939.13	-119.583 (2.6509)	0.91	15679.96	-140.393 (2.1464)	0.80
Asian Paints Ltd.	20.36	-0.00014 (4.6667)	0.63	15.85	0.000082 (3.4167)	0.59

APPENDIX 4A (Contd.)
REGRESSION RESULTS : COST CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S$			Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
18.ALUMINIUM INDUSTRY						
Hindustan Aluminium Corpn. Ltd.	19283.81	-18.53 (0.5636)	0.04	18302.88	0.12 (0.0036)	0.0
Indian Aluminium Co. Ltd.	25949.25	-70.81 (0.8925)	0.13	24815.64	-78.10 (1.0573)	0.12
19.GLASS INDUSTRY						
Borosil Glass Works Ltd.	27517.84	-1443.22 (2.0127)	0.34	18184.14	-826.44 (1.6022)	0.24
J.G. Glass Ltd.	5761.52	-29.58 (2.4226)	0.42	4684.56	-18.99 (1.1989)	0.15
Indoashi Glass Co. Ltd.	28.85	-0.0009 (2.25)	0.42	24.64	-0.001 (1.6667)	0.30
20.IRON & STEEL INDUSTRY						
Bihar Alloy Steels Ltd.	7690.65	-17.35 (0.8929)	0.09	7649.38	-27.39 (1.4068)	0.20
Ferro Alloys Corpn. Ltd.	8738.01	-78.04 (4.8775)	0.75	4040.63	109.51 (6.111)	0.82
Graham Firth Steel Product India Ltd.	7603.09	-124.0 (1.1844)	0.81	5177.97	1655.55 (12.593)	0.17
K.E.C. International Ltd.	5703.99	-6.30 (0.8171)	0.79	6067.24	-10.68 (0.4915)	0.03
Mukund Ltd.	9472.7	-8.93 (1.2595)	0.81	8497.68	6.29 (0.6191)	0.05
Rathi Alloys & Steels Ltd.	13360.94	-69.30 (0.8269)	0.79	11639.61	102.91 (64.44)	0.24
Steel Tubes of India Ltd.	8290.52	-78.87 (1.8645)	0.84	4930.68	77.56 (1.8344)	0.30
Bharat Forge Ltd.	16700.0	-66.81 (1.5044)	0.22	11022.31	-2565.51 (3.3762)	0.59
21.MACHINERY INDUSTRY						
Atlas Copco India Ltd.	150665.3	-2017.56 (0.5906)	0.04	101718.4	8918.44 (1.9879)	0.33
Kirloskar Cummins Ltd.	142969.1	-539.112 (0.7302)	0.06	95244.74	-738.246 (0.4706)	0.55
Kirloskar Pneumatic Co.Ltd.	1178.67	-0.1016 (1.1292)	0.17	1147.78	-0.54 (7.7143)	0.89
The Mysore Kirloskar Ltd.	73989.52	-878.78 (0.9076)	0.09	74331.03	-4386.25 (3.3294)	0.58
Punjab Tractors Ltd.	50340.11	-153.1891 (1.1312)	0.14	43075.34	211.97 (1.5908)	0.24
Ruston & Hornsby (India) Ltd.	82518.67	-2441.56 (1.6054)	0.24	79282.79	-3453.82 (1.653)	0.10
Kelvinator India Ltd.	2574.93	-0.50 (0.8929)	0.36	1994.07	0.44 (1.7302)	0.35

Note : Figures in parantheses show 't' values.
S.E. of P stands for Standard Error of P Estimate.
S.E. of AC stands for Standard Error of AC Estimate.
E-x denotes 10^{-x}

APPENDIX 4B
REGRESSION RESULTS : DEMAND CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S + \gamma F$				Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	Coefft. (γ)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
1.FOOD PRODUCT INDUSTRY							
Britannia Ind. Ltd.	12269.67	-13.47 (1.5411)	269.872 (2.5653)	0.52	10586.05	-11.175 (1.147)	0.33
Milkfood Ltd.	15789.34	-41.203 (0.6854)	304.307 (1.5246)	0.36	15025.61	-70.4386 (1.5562)	0.26
Cadbury India Ltd.	67293.0	-1541.08 (6.033)	667.243 (0.9154)	0.82	46959.78	-1351.29 (4.5239)	0.72
2.VANASPATI INDUSTRY							
The Modern Mills Ltd.	13633.47	-79.68 (1.2771)	-810.05 (1.2726)	0.60	13510.75	-186.927 (3.7045)	0.63
Tungabhadra	14447.21	-66.44 (1.4706)	321.33 (0.7487)	0.24	16643.58	-115.59 (3.8389)	0.65
Amrit Banaspati Ltd.	12693.51	-23.8 (0.9663)	675.46 (1.4207)	0.23	14172.96	-70.82 (3.753)	0.78
3.TEA INDUSTRY							
Assam Co. India Ltd.	21.07	-0.00007 (0.07)	0.0002 (0.20)	0.01	6.86	0.0004 (2.0)	0.32
Assam Frontier Tea Ltd.	10.30	-0.0004 (0.666)	-0.0004 (0.3333)	0.10	9.6	0.0002 (2.0)	0.15
Dooma Dooma India Ltd.	35.38	-0.0044 (4.40)	0.008 (2.6667)	0.59	12.52	-0.0003 (1.0345)	0.12
Tata Tea Ltd.	14.74	-2.0E-7 (0.002)	0.000417 (0.7973)	0.09	15.38	-0.00001 (0.20)	0.01
Warren Tea Ltd.	27.83	-0.0002 (2.0)	-0.0007 (3.50)	0.67	17.24	-0.0005 (5.0)	0.66
4.SUGAR INDUSTRY							
Kesar Sugar Works Ltd.	3.16	-0.000006 (0.5455)	-0.00003 (1.1538)	0.30	2.79	-0.000004 (1.0)	0.08
Kothari Sugars & Chem. Ltd.	3.69	-0.000005 (0.5556)	0.00003 (3.75)	0.56	2.86	0.000012 (0.8571)	0.08
Sri Chmundeswari Sugars Ltd	3.54	-0.000003 (1.0)	-0.000008 (0.8889)	0.18	2.42	0.000002 (0.40)	0.03
5.CIGARETTE INDUSTRY							
G.T.C. Ltd.	0.16	-2.3E-9 (0.7931)	-7.2E-8 (0.2769)	0.24	0.15	2.6E-9 (1.1818)	0.15
I.T.C. Ltd.	0.1641	-4.0E-10 (0.444)	2.5E-8 (2.0833)	0.49	0.13	6.0E-10 (1.2)	0.13
Godfrey Phillips Ltd.	0.13	-7.0E-12 (0.0035)	2.0E-7 (2.0)	0.57	0.14	1.2E-9 (1.7143)	0.26
V.S.T. Ltd.	208.57	-0.00731 (1.1171)	-0.0056 (0.0381)	0.18	186.33	-0.00611 (1.222)	0.16
6.BEVERAGES INDUSTRY							
Arlem Beweries Ltd.	7.23	-0.0002 (0.9524)	0.0019 (0.6185)	0.13	6.40	-0.00018 (2.1429)	0.38
Jagatjit Ind. Ltd.	24.03	-0.00002 (0.0727)	0.000058 (0.029)	0.01	18.15	-0.00018 (1.3846)	0.27
Mohun Meakins Ltd.	52.775	-0.00094 (6.1842)	0.000224 (0.5942)	0.89	44.59	-0.00078 (6.50)	0.87

APPENDIX 4B (Contd.)
REGRESSION RESULTS : DEMAND CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S + \gamma F$				Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	Coefft. (γ)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
7.DRUGS INDUSTRY							
Alembic Chemical Works Ltd	2.18	-0.000002 (1.3077)	.000003 (0.75)	0.21	2.05	-0.000003 (2.2667)	0.56
Glaxo India Ltd.	0.17	-3.7E-9 (2.4667)	6.2E-9 (0.9394)	0.45	0.14	-3.5E-9 (2.1875)	0.37
8.COTTON TEXTILES INDUSTRY							
Ahmedabad Kaiser Hind Mill Ltd.	7.66	-0.00014 (2.2951)	-0.0002 (0.9302)	0.56	-47.8051	0.002836 (3.1616)	0.56
Bharat Vijay Mill Ltd.	14.179	-0.00010 (2.222)	0.00021 (1.0)	0.48	9.4530	-0.00007 (1.6279)	0.43
Lakshmi Mill Co. Ltd.	55860.07	-1216.38 (1.4323)	-1703.94 (0.4925)	0.69	45047.79	-959.403 (3.3553)	0.58
Madura Coats Ltd.	5.43	-.000003 (2.4286)	-.000005 (1.7857)	0.82	4.2062	-0.000003 (3.0006)	0.45
Nutan Mills Ltd.	14.108	-0.00015 (2.1739)	-0.00048 (2.1429)	0.77	10.254	-0.00008 (1.7391)	0.32
Lakshmi Vishnu Textile Mill Co. Ltd.	9.461	-0.000005 (0.1163)	-0.00023 (1.9328)	0.36	12.4337	-0.00011 (4.583)	0.74
Rohit Mills Ltd.	15.267	-0.00011 (1.2791)	-0.00123 (1.1357)	0.34	11.9214	-0.00011 (2.0755)	0.35
9.WOOLLEN TEXTILES INDUSTRY							
L.D. Textile Ind. Ltd.	48505.19	-2887.12 (0.9856)	-11755.1 (1.2432)	0.35	34297.69	4241.527 (0.7414)	0.08
Shri Dinesh Mills Ltd.	115.51	-0.02 (2.0)	0.02 (0.6667)	0.84	93.64	-0.02 (10.0)	0.91
Reliance Ind. Ltd.	1139184	-13.97 (0.0614)	-2642.87 (1.5201)	0.62	88078.0	-289.7 (2.6368)	0.46
Shri Rajasthan Syntex Ltd.	68106.72	-924.1511 (0.3013)	-18432.9 (5.0051)	0.81	46787.91	3887.87 (0.8884)	0.10
10.MAN MADE FIBRE INDUSTRY							
Shree Synthetic Ltd.	93414.98	-1716.0 (1.3454)	9069.93 (0.9625)	0.21	75891.27	-1623.52 (2.9819)	0.77
National Rayons Corporation Ltd.	42322.29	-6.819 (0.0313)	-804.875 (0.3617)	0.04	114617.7	-3809.49 (6.459)	0.84
Indian Organic Chemicals Ltd.	59120.13	-338.1494 (0.6483)	997.446 (0.1574)	0.29	68929.72	-1406.54 (2.0759)	0.51
11.LEATHER & FOOTWEAR INDUSTRY							
Carona Ltd.	21.23	-0.00025 (1.6556)	-0.00043 (1.1911)	0.58	17.46	-0.0003 (3.6585)	0.62
12.TWO WHEELER INDUSTRY							
Bajaj Auto Ltd.	517.66	-0.03 (0.0556)	-10.92 (0.7032)	0.22	4001.23	0.01 (0.0435)	0.0003
Maharashtra Scooters Ltd.	5978.69	-3.45 (1.1815)	94.35 (0.3574)	0.17	5532.38	-3.83 (1.0079)	0.11
Automobile Products of India Ltd.	18030.45	-188.57 (1.9107)	-1286.87 (1.3653)	0.69	15452.77	-253.11 (5.0632)	0.76

APPENDIX 4B (Contd.)
REGRESSION RESULTS : DEMAND CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S + \gamma F$				Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	Coefft. (γ)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
13.CEMENT INDUSTRY							
The Andhra Cement Co. Ltd.	282.82	-0.30 (1.6667)	-0.06 (0.0698)	0.42	194.14	0.18 (2.25)	0.43
Dalmia Cement Ltd.	1066.21	-0.30 (1.50)	-3.35 (1.7539)	0.46	865.2	-0.44 (2.0952)	0.36
Mysore Cement Ltd.	676.85	-0.002 (0.0154)	-0.93 (0.5225)	0.15	506.61	-0.03 (0.6)	0.06
Shri Digvijay Cement Co. Ltd.	391.42	-0.05 (0.3125)	1.60 (2.1053)	0.65	289.22	0.16 (1.333)	0.23
Madras Cement Ltd.	563.87	-0.008 (0.0571)	-0.24 (0.1333)	0.01	411.06	-0.07 (1.0)	0.10
14.PAPER INDUSTRY							
Balkrishna Ind. Ltd.	6434.57	-4.37 (0.4190)	-363.49 (2.1129)	0.42	5442.083	-13.02 (0.9617)	0.10
The Mysore Paper Mills Ltd.	6626.20	-0.67 (0.1727)	-4.82 (0.1530)	0.07	6086.43	-5.33 (2.9286)	0.52
NEPA Ltd.	5743.32	-4.81 (0.9857)	-44.96 (0.8107)	0.20	4887.82	-2.54 (0.4448)	0.03
Sheshasayee Paper & Board Ltd.	7838.62	-15.64 (0.8400)	-8.91 (0.2174)	0.11	7023.95	-23.5 (0.6763)	0.05
Star Paper Mills Ltd.	7787.91	-23.67 (1.1009)	15.31 (0.5509)	0.17	5297.96	34.79 (1.019)	0.11
Ballarpur Ind. Ltd.	5143.98	-3.61 (0.0857)	-149.73 (0.4739)	0.03	4451.93	-27.29 (0.5532)	0.04
15.FERTILISER INDUSTRY							
The Dharamsi Morarji Chemical Co. Ltd.	1248.63	-0.46 (1.3939)	-0.71 (0.3622)	0.55	1184.1	-0.63 (2.8636)	0.49
Excel Ind. Ltd.	250147	-5620.28 (1.4033)	-160527 (5.3808)	0.90	167666.2	-15983.5 (2.6866)	0.47
Fertiliser & Chemical Travancore Ltd.	2330.14	-0.67 (8.375)	1.24 (2.6383)	0.92	2094.96	-0.53 (3.5333)	0.60
Gujarat State Fertiliser Co. Ltd.	4624.27	-2.50 (3.3333)	7.18 (1.8845)	0.75	3247.11	-0.64 (2.56)	0.45
16.CHEMICAL INDUSTRY							
Aegis Chemicals Ltd.	15201.37	-107.57 (0.9321)	799.20 (0.9571)	0.14	12203.34	-62.25 (0.4514)	0.03
Citurgia Biochemicals Ltd.	2972.10	-5.22 (10.875)	8.38 (1.4325)	0.95	1491.71	6.38 (2.786)	0.52
Gujarat Alkalies & Chemical Ltd.	3526.78	-1.62 (2.6558)	-28.97 (1.1352)	0.73	1944.70	3.41 (2.2288)	0.38
Polyoefin Ind. Ltd.	19241.07	-33.19 (3.5688)	55.72 (0.6589)	0.67	16511.05	-41.81 (2.7009)	0.48
Deepak Nitrides Ltd.	1537.46	-1.44 (2.88)	3.99 (0.8867)	0.73	1054.72	0.12 (0.3529)	0.02
17.PAINT INDUSTRY							
Garware Paints Ltd.	28461.29	-68.49 (0.1585)	-1038.14 (1.0195)	0.17	21410.49	-419.013 (2.9916)	0.70
Goodlass & Nerolac Paints Ltd.	23603.46	-214.99 (0.8039)	-133.57 (0.0752)	0.14	20576.68	121.48 (1.6744)	0.89
Berger Paints Ltd.	14300.60	-68.051 (0.9474)	2189.16 (4.0513)	0.74	15679.96	-140.393 (2.1464	0.80
Asian Paints Ltd.	19.98	-0.000087 (1.2429)	0.00037 (0.4248)	0.64	15.85	0.000082 (3.4167)	0.59

APPENDIX 4B (Contd.)
REGRESSION RESULTS : DEMAND CATEGORY

Name of the Industry and Firm	Demand Function $P = \alpha + \beta S + \gamma F$				Average Cost Function $AC = a_0 + a_1 Y$		
	Intercept (α)	Coefft. (β)	Coefft. (γ)	R^2	Intercept (a_0)	Coefft. (a_1)	R^2
18.ALUMINIUM INDUSTRY							
Hindustan Aluminium Corpn. Ltd.	18989.12	-74.63 (1.1852)	-739.48 (1.0427)	0.17	18302.88	0.12 (0.0036)	0.0
Indian Aluminium Co. Ltd.	27770.47	-46.04 (0.6073)	-117.21 (0.3457)	0.06	24815.64	-78.10 (1.0573)	0.12
19.GLASS INDUSTRY							
Borosil Glass Works Ltd.	25614.49	-1734.21 (1.7556)	2133.66 (0.4572)	0.36	18184.14	-826.44 (1.6022)	0.24
J.G. Glass Ltd.	5397.64	-40.88 (2.5808)	268.28 (1.0994)	0.51	4684.56	-18.99 (1.1989)	0.15
Indoashi Glass Co. Ltd.	28.11	-0.001 (1.6667)	0.002 (0.3333)	0.42	24.64	-0.001 (1.6667)	0.30
20.IRON & STEEL INDUSTRY							
Bihar Alloy Steels Ltd.	8522.65	-4.56 (0.2083)	-170.42 (1.6746)	0.35	7649.38	-27.39 (1.4068)	0.20
Ferro Alloys Corpn. Ltd.	7393.73	-81.31 (4.5197)	136.26 (0.5069)	0.76	4040.63	109.51 (6.111)	0.82
Graham Firth Steel Product India Ltd.	6259.20	-240.46 (2.0153)	-1287.64 (0.6332)	0.37	5177.97	1655.55 (12.593)	0.17
K.E.C. International Ltd.	8424.62	-11.66 (0.9418)	-205.43 (2.7119)	0.55	6067.24	-10.68 (0.4915)	0.03
Mukund Ltd.	8977.19	-10.49 (0.5900)	6.39 (0.0692)	0.11	8497.68	6.29 (0.6191)	0.05
Rathi Alloys & Steels Ltd.	13451.51	-47.70 (0.3760)	581.47 (0.9034)	0.58	11639.61	102.91 (64.44)	0.24
Steel Tubes of India Ltd.	6360.64	-15.85 (0.2407)	492.12 (2.3569)	0.57	4930.68	77.56 (1.8344)	0.30
Bharat Forge Ltd.	16485.55	-24.97 (0.1050)	-710.78 (0.3935)	0.24	11022.31	-2565.51 (3.3762)	0.59
21.MACHINERY INDUSTRY							
Atlas Copco India Ltd.	151503.3	-2955.15 (0.6944)	-7387.12 (0.4154)	0.07	101718.4	8918.44 (1.9879)	0.33
Kirloskar Cummins Ltd.	144469.2	-490.816 (0.6365)	-4697.8 (0.6371)	0.11	95244.74	-738.246 (0.4706)	0.55
Kirloskar Pneumatic Co.Ltd.	1179.347	-0.1206 (1.2561)	1.1659 (1.2663)	0.20	1147.78	-0.54 (7.7143)	0.89
The Mysore Kirloskar Ltd.	72554.20	-1336.88 (0.7959)	3271.07 (0.9727)	0.20	74331.03	-4386.25 (3.3294)	0.58
Punjab Tractors Ltd.	50412.39	-167.74 (1.1095)	-347.47 (0.3114)	0.15	43075.34	211.97 (1.5908)	0.24
Ruston & Hornsby (India) Ltd.	85493.55	-2766.89 (1.6530)	-4671.84 (0.6045)	0.28	79282.79	-3453.82 (1.653)	0.10
Kelvinator India Ltd.	2512.19	-0.2523 (1.7302)	-1.48 (0.9629)	0.31	1994.07	0.44 (1.7302)	0.35

Note : Figures in parantheses show 't' values.
S.E. of P stands for Standard Error of P Estimate.
S.E. of AC stands for Standard Error of AC Estimate.
E-x denotes 10^{-x}

CHAPTER 5

EMPIRICAL FINDINGS : FULL MODEL

The relationship that exists between the price-cost margin and inventory holding under different motives has been discussed theoretically and empirically in the earlier chapters of this thesis. Such an analysis helps us in judging which category of motives of inventory holding is better in terms of the performance of the firm.

The objective of this chapter is to study empirically the relationship between the price-cost margin and inventory holding without considering each motive of inventory holding separately. That is, in this chapter the emphasis is given on finding out the direct impact of inventory holding on the performance of the firm. In other words, we are not interested in studying whether the variation in the price-cost margin of a firm is brought about by changes in the demand curve and/or changes in the cost curve. That is, we are interested in studying the overall contribution of finished product inventory in the price-cost margin of the firms. The cross-section of the firms chosen for this study is same as used earlier (See Appendix 3A).

5.1 THE MODEL

For empirical verification of the relationship between price-cost margin and inventory holdings by the firms the

following three different specifications of the model were chosen:

$$Z = \alpha + \beta F + u \qquad (5.1)$$

$$Z = a_0 + a_1 F + a_2 F^2 + u \qquad (5.2)$$

$$Z = b_0 + b_1 F' + u \qquad (5.3)$$

where Z is the price-cost margin as defined earlier, F represents finished product inventory in physical terms at the end of the accounting period, and F' shows the ratio of inventory holding (F) to sales. u is the random error term.

The linear relationship between Z and F as shown by Equation (5.1) may be positive or negative depending on the nature of the industry, firms specific conditions particularly related to demand and costs. A priorily it is difficult to generalize in this regard. The quadratic relationship as shown by expression (5.2) is based on the assumption that initially it is advantageous for the firm to hold inventory in greater magnitude since it stabilizes its demand and saves certain costs. But too much inventory holding means extra costs and blocking of capital for longer period and hence a negative relationship between price-cost margin and inventory holding. It gives us an idea of optimum inventory holding shown by the peak of the curve. The third specification i.e. (5.3) is also a linear one only like specification (5.1) with a replacement of F by F'. Firm's decision regarding production and inventory might be based on a rate of inventory (i.e. inventory/sales ratio or sales time of inventory) rather than absolute amount of it. Specification (5.3) is being used to test this proposition.

Preliminary round of regression analysis has not supported the quadratic specification (5.2) and the inventory-rate specification (5.3) of the model. This left only the linear specification (5.1) for empirical verification of the relationship between price-cost margin (Z) and inventory holdings (F).

5.2 REGRESSION RESULTS

The final regression results based on the linear specification of the relationship between Z and F for different categories of industries are given in Table 5.1. As mentioned earlier, the cross-section of the firms in each industry group is exactly the same as used for the analysis presented in Chapter 4 of this thesis. This helps us in comparing the results of the two different approaches of finding the impact of inventory holding on price-cost margin of the firms. A brief discussion and interpretation of the results for different industries is given below.

(i) Consumer Non Durable Group of Industries

This group of industries includes Food Product industry, Tea industry, Sugar industry, Cigarette industry, Beverages and Drugs industry.

In the Food Product industry with a sample of three firms, the regression model performed fairly well as indicated by the value of R^2 and the 't' values of the coefficients. In all the three firms, the Beta coefficient is positive and significant thus showing that inventory holding has a positive impact on the price-cost margin.

In the Vanaspati industry the value of R^2 and the 't' values of the coefficients show that price-cost margin varies positively and significantly in all the three firms of the sample taken.

In the Tea industry, the β coefficient is insignificant in the case of three firms while it is significant in the case of two firms. The results show that inventory holding has a weak positive relationship in the case of three firms while it has a significant positive relationship in the case of two firms. On the whole, there is a positive relationship between the price-cost margin and inventory holding in the Tea industry.

The regression results of the Sugar industry show that in a sample of three firms, finished product inventory has a positive impact on the price-cost margin in the case of all three firms, the relationship being significant in the case of one firm and insignificant for the remaining two firms.

In the Cigarette industry, the regression results show that inventory holding has a positive and significant relationship in the case of three firms, but positive and insignificant in the case of one firm. These results show that inventory holding varies positively with the price-cost margin in all the four firms of the sample taken from the Cigarette industry.

In a sample of three firms taken from the Beverages industry, the regression results show that β coefficient is positive and significant in the case of two firms while it is positive and insignificant in the case of one firm. Thus, by and large, there is a positive relationship between the price-cost margin and

inventory holding in all the firms of this industry also.

In the Drugs industry a sample of two firms was taken. The value of R^2 and 't' values show that β coefficient is insignificant in the case of both the firms. However, inventory has a weak positive influence on the price-cost margin for both the firms.

On the whole, we find that inventory holding varies positively with price-cost margin in the case of all the firms belonging to different industries in the consumer non durable group. Most of the industries belonging to this group show high proportion of fixed costs in total cost of production. Such industries do maintain a higher level of intended inventory accumulation of their products by producing more output in order to reduce the fixed costs. Thus a reduction in cost of production implies an increase in price-cost margin and so a positive relationship between price-cost margin and inventory accumulation, as reflected by the regression results is a strong plausibility. Indirectly, we say that the economies of scale motive of inventory holding is the source of the increase in price-cost margins of the industries. Taking the example of Food Products industry, where the proportion of fixed costs was found to be as high as 50%, higher inventory accumulation means more utilization of fixed resources which results in a decline in average cost of production and hence an increase in its price-cost margin.

Another reason for a positive relationship between price-cost margin and inventory holding in consumer non durable industry

group is that the sales time of inventory is very low. This is one reason why inventory carrying cost per unit of output is a decreasing function of production and thus inventory has a positive impact on the price-cost margin in this industry group. One more reason which can be given to explain the positive relationship is that consumer non durable products are a necessity and if a particular brand of product is not available in the market, the consumer easily switches over to another brand which is available in the market. Thus by holding inventory the firm is able to shift the demand curve of its product to the right, the ultimate effect of which is an increase in price-cost margin with increasing level of finished product inventory in the industries.

(ii) Consumer Durable Group of Industries

Five industries namely Cotton Textile industry, Woollen Textile industry, Man Made Fibre industry, Footwear industry and the Two Wheeler industry were taken in this group of industries. The Cotton Textile industry having a sample of seven firms, shows mixed pattern of behaviour with respect to the relationship between Z and F. It was found significant in the case of three firms out of which only one has shown positive relationship and two showed a negative relationship between price-cost margin and inventory holding. Direction wise, four firms show positive and three show negative relationship.

In the Woollen Textile industry a sample of four firms has been taken. The value of R^2 and 't' value of the β coefficient showed that inventory holding is positively and significantly related with price-cost margin in the case of two firms, positive

but insignificant in the case of one firm, and negative but insignificantly linked in the case of another firm.

In the Man Made Fibre industry out of a sample of 3 firms, price-cost margin varies positively with inventory in the case of two firms, significant being only in the case of one firm. It is negative and weakly significant ($t > 1$) in the case of remaining one firm.

In case of Footwear industry, a sample of one firm shows that inventory holding has a negative and significant impact on price-cost margin. The reason for negative relationship is that there is excess supply and thus consumers have stronger bargaining power over manufacturers and thus inventory has a negative impact on profit.

In the Two Wheeler industry, in a sample of three firms β coefficient is significant in the case of only one firm and insignificant in the case of two firms. Direction wise the results show that finished product inventory has a positive impact on the price-cost margin in the case of two firms and negative impact in the case of one firm. In the Two wheeler industry there is an excess capacity and thus firms are able to enjoy the advantage of economies of scale to some extent by holding inventory. But this benefit is compensated by increase in inventory carrying cost because huge investment is involved in inventory holding and a recessionary situation is prevailing in automobile industry.

Taking the consumer durable group of industries as a whole, we find that the relationship between finished product inventory and price-cost margin differs from firm to firm. Thus the nature of industry does not play much role in determining this relationship. It is internal decisions of firms which play an important role in describing the relationship between finished product inventory and price-cost margin.

(iii) Producer Non Durable Group of Industries

The industries included in this group are Cement industry, Paper industry, Fertilizer industry, Chemical industry and Paint industry.

In the Cement industry, a sample of five firms has been selected. The results show that product inventory has a positive and significant impact on price-cost margin in the case of three firms, positive but insignificant in the case of one firm, and negative impact but insignificant for the remaining one firm.

In the Paper industry, in a sample of six firms, β coefficient is significant in case of three firms and insignificant in case of remaining three firms. The results show that there is a positive relationship between the price-cost margin and inventory holding in the case of three firms, significant in one firm and insignificant for the other two; and a negative relationship in the case of three other firms with one having insignificant and two having significant coefficients. Thus, the pattern of the relationship between price-cost margin and inventory holding is quite mixed in this industry.

In the Fertiliser industry, a sample of four firms has been selected. the value of R^2 and 't' value of coefficients show that β coefficient is significant in the case of only one firm and insignificant for the remaining three firms. The results show that inventory has a positive impact on the price-cost margin in the case of three firms and negative impact in the case of remaining one firm.

In the Chemical industry, out of a sample of six firms, β coefficient is significant in the case of two firms and insignificant in the case of remaining four firms. Direction wise, the regression results show that inventory holding has a negative relationship with price-cost margin in the case of four firms and a positive relationship in the case of remaining two firms.

In the Paint industry, a sample of four firms has been chosen. The value of R^2 and 't' value of the coefficients show that it is significant in the case of two firms and insignificant in the case of remaining two firms. The direction of causation however is positive in the case of three firms and negative for the remaining one firm.

(iv) Producer Durable Group of Industries

The industries included in this group are: Aluminum Industry, Glass Industry, Iron and Steel Industry and Machinery Industry.

In the Aluminium industry, a sample of two firms is taken for the study. The β coefficient is significant for both the firms. The regression results show that inventory holding has a positive

there is effective inventory management, the relationship between price-cost margin and inventory seems to be positive while it is negative in the case of the firms which do not have a good inventory management policy.

5.3 A COMPARATIVE EVALUATION OF THE METHODOLOGIES OF STUDY

The effect of inventory holding on price-cost margins of the firms has been studied by us in two different ways as described in Chapter 4 and in this chapter. A comparative picture that emerges from this study is summarised in this section.

Table 5.2 shows the comparative picture of the direction of the total impact of inventory holdings on price-cost margin as obtained through the disaggregated model of Chapter 4 and as obtained through the full model of this chapter.

When we compare the total effect of inventory holding on price-cost margin of the disaggregated model (of Chapter 4) with the total effect of the full model (of this Chapter), we find ambiguity in some cases. The ambiguity arises in the sense that the signs of the effect of inventory holding on price-cost margin are different in some cases. Also, the value of coefficients differ even when the signs are the same in some cases (See Table 5.2). However, in most cases where there is ambiguity, the coefficients were observed to be insignificant. The reasons for ambiguity can be explained as follows:

(i) In the disaggregated model of Chapter 4, the change in inventory is brought about by changing production. However, in this chapter we do not incorporate any such specific

assumption and assume that price-cost margin is a simple linear function of finished product inventory.

(ii) In the disaggregated model of Chapter 4, the variation in average cost of production arises through changes in the level of production. By assuming that change in inventory is brought about by changing production, we find the impact of inventory on average cost. That is, the impact of production on average cost is same as the impact of inventory on average cost. However, in this chapter we do not make any direct assumption of this kind.

(iii) In the disaggregated model, we assume that variation in the price-cost margin is brought about through changes in average cost function and demand function. However, in the full model of this chapter, we do not make any assumption of this kind.

(iv) In the disaggregated model, the price-cost margin is not a linear function of inventory whereas in this chapter, we are assuming price-cost margin to be a linear function of the level of finished product inventory.

The disaggregated model of Chapter 4 is better than the full model of this chapter on account of the following reasons:

(i) With the disaggregated model we are able to know the causes of the impact of finished product inventory on the price-cost margin. That is, we are able to know how much variation in the price-cost margin is brought about by average cost function and how much by demand function.

(ii) Since holding an additional unit of inventory requires an increase in production by one unit, it changes the average cost of production. It is always better to include the level of production in average cost function than the level of finished product inventory (as done in the model of Chapter 4) because any increase in total cost is distributed over the entire production rather than just over the finished product inventory. However, in this chapter, by assuming the price-cost margin as a simple linear function of finished product inventory, we assume (although indirectly) that any increase in total cost is distributed over finished product inventory and not over production.

(iii) A change in inventory is brought about either by changing production or sales. In Chapter 4 we incorporate this assumption. However, in this Chapter we do not incorporate any such assumption. The impact of inventory on price-cost margin should be studied by considering how change in inventory is brought about, that is, whether it is brought about by changing production or by changing sales because each of these changes give different impacts.

(iv) In the disaggregated model of Chapter 4, it can be seen that price-cost margin is not a linear function of finished product inventory, whereas in the direct model of this chapter, price-cost margin is assumed to be a linear function of finished product inventory. Thus, there might be a misspecification of the model in this chapter. Because of this reason also the disaggregated model of Chapter 4 is

superior to the direct model of Chapter 5 for analysing the relationship between finished product inventory and price-cost margin.

5.4 SUMMARY

In this chapter we studied empirically the impact of inventory holding on the price-cost margin of the firms of different Indian industries directly. That is, price-cost margin was taken to be a linear function of finished product inventory without considering the motives of inventory holding separately.

The industries were divided into four broad categories namely consumer non durables, consumer durables, producer non durables and producer durables.

The results, by and large, showed that inventory has a positive impact on the price-cost margin in the case of all the firms in the industries of consumer non durable category. In the case of the industries of other categories the relationship is not clear. In the industries belonging to the consumer non durable group, inventory management does not play an important role as the sales time of inventory is very small in such industries, and so, the relationship between profit and inventory does not differ from firm to firm. On the other hand, sales time of inventory is sufficiently large in the case of consumer durable, producer non durable and producer durable industries. In such industries, as we interpret, inventory management plays an important role. The firms, which have good inventory management, have a positive impact of inventory on their price-cost margins while those, which

have poor inventory management, might have a negative impact. This might be the reason for the existence of both types of relationships in these categories. That is, firm specific decision variables related to inventory management play crucial role in affecting the price-cost margins.

Table 5.1

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$

Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Error of Z estimate (SE_Z)
1. FOOD PRODUCT INDUSTRY				
Britannia Inds. Ltd.	0.136545	0.004604 (1.0581)	0.12	0.016615
Milkfood Ltd.	0.078230	0.023537 (3.9785)	0.66	0.025793
Cadbury India Ltd.	0.2526675	0.030268 (1.4127)	0.20	0.024759
2. VANASPATI INDUSTRY				
The Modern Mills Ltd.	-0.04803	0.041900 (2.0409)	0.34	0.03493
Tungabhadra	-0.07869	0.042026 (3.0008)	0.53	0.048661
Amrit Banaspati Ltd.	0.01476	0.012846 (1.0807)	0.28	0.00974
3. TEA INDUSTRY				
Assam Co. India Ltd.	0.356351	0.014207 (0.4940)	0.03	0.093460
Assam Frontier Tea Ltd.	0.239415	0.001475 (0.0589)	0.0004	0.085062
Dooma Dooma India Ltd.	0.305213	0.031503 (6.1326)	0.82	0.090663
Tata Tea Ltd.	0.133338	0.008776 (1.0974)	0.13	0.058531
Warren Tea Ltd.	0.421234	0.002592 (0.3862)	0.02	0.075951
4. SUGAR INDUSTRY				
Kesar Sugar Works Ltd.	0.186183	0.000040 (0.004)	0.0	0.081297

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$

Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Er of Z estima (SE_Z)
Kothari Sugars & Chemicals Ltd.	0.101994	0.007497 (1.4473)	0.21	0.055203
Sri Chmundeswari Sugars Ltd.	0.143089	0.010196 (0.7389)	0.07	0.112724
5. CIGARAETTE INDUSTRY				
GTC Ltd.	0.008397	0.0000003502 (0.3953)	0.02	0.060064
ITC Ltd.	0.058251	0.0000000344 (2.7087)	0.48	0.01879
Godfrey Phillips Ltd.	-0.04737	0.000000583 (1.6816)	0.26	0.056680
VST Ltd.	73.89705	1077.040 (1.1585)	0.14	77.65606
6. BEVERAGES INDUSTRY				
Arlem Beweries Ltd.	0.141107	0.000215 (2.15)	0.36	0.039153
Jagatjit Industries Ltd.	0.251630	0.000004 (0.3636)	0.02	0.44051
Mohun Meakins Ltd.	0.139474	0.000008 (1.6)	0.29	0.019216
7. DRUGS INDUSTRY				
Alembic Chemical Works Ltd.	0.150202	0.000001 (1.0)	0.24	0.035086
Glaxo India Ltd.	0.177005	0.0000000583 (1.5588)	0.23	0.048382

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$

Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Er of Z estima (SE_Z)
8. COTTON TEXTILE INDUSTRY				
Ahmedabad Kaiser Hind Mill Ltd.	-6.13284	0.002588 (3.5795)	0.62	1.852599
Bharat Vijay Mill Ltd.	0.332805	-0.00002 (2.8571)	0.58	0.040471
Lakshmi Mills Co. Ltd.	0.183336	-0.03382 (1.3642)	0.36	0.020092
Madura Coats Ltd.	0.173029	0.0000004821 (0.7323)	0.06	0.053838
Nutan Mills Ltd.	0.179070	0.00002 (0.8696)	0.12	0.056638
Lakshmi Vishnu Textile Mills Co. Ltd.	-0.03798	0.000005 (0.25)	0.01	0.108344
Rohit Mills Ltd.	0.195093	-0.00007 (0.9722)	0.11	0.052077
9. WOOLLEN TEXTILES INDUSTRY				
LD Textile Inds. Ltd.	0.031719	0.438018 (2.6643)	0.54	0.058804
Shri Dinesh Mills Ltd.	0.165045	0.000215 (8.2692)	0.89	0.01474
Reliance Ind. Ltd.	0.198234	0.001753 (0.7975)	0.07	0.026703
Shri Rajasthan Syntex Ltd.	0.190478	-0.00738 (0.3129)	0.01	0.01367
10. MAN MADE FIBRE INDUSTRY				
Shree Synthetic Ltd.	0.175998	-0.05503 (1.1338)	0.14	0.041429

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$

Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Er of Z estima (SE_Z)
National Rayons Corporation Ltd.	-0.118601	0.762517 (2.7861)	0.49	0.538224
Indian Organic Chemicals Ltd.	0.067661	0.068493 (0.9447)	0.10	0.054205
11. LEATHER, LEATHER PRODUCT & FOOTWEAR INDUSTRY				
Carona Ltd.	0.212857	-0.0000064261 (1.3791)	0.21	0.019822
12. MOTOR CYCLES, SCOOTERS ETC. INDUSTRY				
Bajaj Auto Ltd.	0.226895	-0.00136 (0.8757)	0.09	0.040767
Maharashtra Scooters Ltd.	0.084806	0.008387 (0.3314)	0.01	0.02257
Automobile Products of India Ltd.	0.007711	0.036206 (1.0502)	0.13	0.041093
13. CEMENT INDUSTRY				
The Andhra Cement Co. Ltd.	0.355755	-0.00064 (0.6219)	0.05	0.089258
Dalmia Cement Ltd.	0.102723	0.002433 (2.0795)	0.35	0.061204
Mysore Cement Ltd.	0.242439	0.000226 (0.4913)	0.03	0.060351
Shri Digvijay Cement Co. Ltd.	0.089768	0.000258 (1.4576)	0.26	0.024102
Madras Cement Ltd.	0.266596	0.001622 (2.0715)	0.35	0.048928

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$				
Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Er of Z estima (SE_Z)
14. PAPER INDUSTRY				
Balkrishna Inds. Ltd.	0.176716	-0.01089 (0.3786)	0.02	0.035763
The Mysore Paper Mills Ltd.	0.102144	0.003164 (0.8875)	0.09	0.060540
NEPA Ltd.	0.109147	0.010786 (0.7135)	0.06	0.050478
Seshasayee Paper & Board Ltd.	0.224664	-0.01610 (1.4611)	0.21	0.069269
Star Paper Mills Ltd.	0.021378	0.002135 (1.5283)	0.44	0.006368
Ballarpur Inds. Ltd.	0.619967	-0.07280 (1.1466)	0.40	0.025671
15. FERTILISER INDUSTRY				
The Dharamsi Morarji Chemical Co. Ltd.	0.081200	0.000864 (0.5427)	0.04	0.141875
Excel Inds. Ltd.	0.230858	0.119489 (1.4518)	0.21	0.031932
Fertiliser & Chemical Travancore Ltd.	0.164774	0.000010 (0.0290)	0.0001	0.052944
Gujarat State Fertiliser Co. Ltd.	0.217137	-0.00014 (0.6512)	0.05	0.040285
16. CHEMICAL INDUSTRY				
Aegis Chemicals Ltd.	0.237116	-0.01429 (0.2792)	0.01	0.058379

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$

Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Er of Z estima (SE_Z)
Citurgia Biochemicals Ltd.	0.310020	0.016971 (1.1781)	0.15	0.071545
Gujarat Alkalis & Chemicals Ltd.	0.389332	-0.05139 (2.2724)	0.39	0.074724
Polyoefin Inds. Ltd.	0.258702	-0.00612 (0.5764)	0.04	0.057478
Deepak Nitrides Ltd.	0.456594	-0.00988 (2.0932)	0.36	0.062049
17. PAINT INDUSTRY				
Garware Paints Ltd.	0.239432	0.019205 (1.4183)	0.20	0.030966
Goodlass & Nerolac Paints Ltd.	0.231306	-0.00891 (1.5501)	0.38	0.009192
Berger Paints Ltd.	0.196816	0.000561 (0.0484)	0.0003	0.024254
Asian Paints Ltd.	0.215605	0.003786 (0.3296)	0.01	0.037013
18. ALUMINIUM INDUSTRY				
Hindustan Aluminium Corporation Ltd.	0.057413	0.010681 (1.9634)	0.33	0.038192
Indian Aluminium Co. Ltd.	0.295351	-0.00615 (1.1431)	0.13	0.045365
19. GLASS INDUSTRY				
Borosil Glass Works Ltd.	0.252419	0.029967 (1.1526)	0.14	0.026617
JG Glass Ltd.	0.097089	0.017800 (0.6453)	0.05	0.117536

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$				
Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Er of Z estima (SE_Z)
Indoasahi Glass Co. Ltd.	0.320712	-0.00003 (0.0357)	0.02	0.057413
20. IRON & STEEL INDUSTRY				
Bihar Alloy Steels Ltd.	0.015960	0.011360 (1.9280)	0.32	0.050228
Ferro Alloys Corpn. Ltd.	-0.01896	0.027867 (1.2616)	0.17	0.071884
Graham Firth Steel Product India Ltd.	0.018495	0.287031 (1.8109)	0.29	0.067662
KEC International Ltd.	-0.09129	0.020066 (1.9846)	0.36	0.078172
Mukund Ltd.	0.072119	0.002118 (2.9873)	0.53	0.013449
Rathi Alloys & Steel Ltd.	0.098267	0.011364 (1.0650)	0.12	0.052194
Steel Tubes of India Ltd.	0.165118	0.002820 (0.7330)	0.06	0.017571
Bharat Forge Ltd.	0.176919	0.004545 (0.6879)	0.06	0.026702
21. MACHINERY INDUSTRY				
Atlas Copco India Ltd.	0.266940	-0.06348 (0.4019)	0.02	0.034814
Kirloskar Cummins Ltd.	0.358669	-0.22536 (1.8230)	0.29	0.049469
Kirloskar Pneumatic Co. Ltd.	0.035890	0.003934 (5.3090)	0.78	0.038415
The Mysore Kirloskar Ltd.	-0.06177	0.259272 (4.0897)	0.68	0.029549

Table 5.1 (Contd.)

REGRESSION RESULTS : FULL MODEL

Regression Equation : $Z = \alpha + \beta F + u$				
Name of the Industry & Firm	Intercept (α)	Coefficient (β)	Coefficient Determination (R^2)	Standard Err of Z estimat (SE_Z)
Punjab Tractors Ltd.	0.122104	0.018136 (1.4959)	0.22	0.012133
Ruston & Hornsby (India) Ltd.	-0.05154	0.322543 (2.8882)	0.51	0.021722
Kelvinator India Ltd.	0.151624	0.000099 (0.1371)	0.002	0.027220

Figures in parantheses show 't' values.

Table 5.2

DIRECTION OF TOTAL IMPACT OF INVENTORY HOLDINGS ON PRICE-COST MARGIN

Name of Industry Group and Firms	Obtained Through the Disaggregated Model (Chapter 4)	Obtained Through the Full Model (Chapter 5)
1. FOOD PRODUCT INDUSTRY		
Britannia Ind. Ltd.	+	+ *
Milkfood Ltd.	+	+ *
Cadbury India Ltd.	+	+ *
2. VANASPATI INDUSTRY		
The Modern Mills Ltd.	–	+ *
Tungabhadra	+	+ *
Amrit Banaspati	+	+ *
3. TEA INDUSTRY		
Assam Co. India Ltd.	–	+
Assam Frontier Tea Ltd.	–	+
Dooma Dooma India Ltd.	+	+ *
Tata Tea Ltd.	+	+ *
Warren Tea Ltd.	+	+
4. SUGAR INDUSTRY		
Kesar Sugar Works Ltd.	–	+
Kothari Sugars & Chemicals Ltd.	+	+ *
Sri Chmundeswari Sugars Ltd.	–	+
5. CIGARETTE INDUSTRY		
GTC Ltd.	–	+
ITC Ltd.	+	+ *
Godfrey Phillips Ltd.	+	+ *
VST Ltd.	–	+ *
6. BEVERAGES INDUSTRY		
Arlem Beweries Ltd.	+	+ *
Jagatjit Industries Ltd.	+	+
Mohun Meakins Ltd.	+	+ *
7. DRUGS INDUSTRY		
Alembic Chemical Works Ltd.	+	+ *
Glaxo India Ltd.	+	+ *

Table 5.2 (Contd.)

DIRECTION OF TOTAL IMPACT OF INVENTORY HOLDINGS ON PRICE-COST MARGIN

Name of Industry Group and Firms	Obtained Through the Disaggregated Model (Chapter 4)	Obtained Through the Full Model (Chapter 5)
8. COTTON TEXTILE INDUSTRY		
Ahmedabad Kaiser Hind Mill Ltd.	−	+ *
Bharat Vijay Mill Ltd.	+	− *
Lakshmi Mills Co. Ltd.	−	− *
Madura Coats Ltd.	−	+
Nutan Mills Ltd.	−	+
Lakshmi Vishnu Textile Mills Co. Ltd.	−	+
Rohit Mills Ltd.	−	− *
9. WOOLLEN TEXTILE INDUSTRY		
LD Textile Ind. Ltd.	−	+ *
Shri Dinesh Mills Ltd.	+	+ *
Reliance Ind. Ltd.	−	+
Shri Rajasthan Syntex Ltd.	−	−
10. MAN MADE FIBRE INDUSTRY		
Shree Synthetic Ltd.	+	− *
National Rayons Corporation Ltd.	+	+ *
Indian Organic Chemicals Ltd.	+	+ *
11. LEATHER, LEATHER PRODUCTS & FOOTWEAR INDUSTRY		
Carona Ltd.	−	− *
12. MOTOR CYCLES, SCOOTERS ETC. INDUSTRY		
Bajaj Auto Ltd.	−	−
Maharashtra Scooters Ltd.	+	+
Automobile Products of India Ltd.	−	+ *
13. CEMENT INDUSTRY		
Andhra Cement Co. Ltd.	−	−
Dalmia Cement Ltd.	−	+ *
Mysore Cement Ltd.	−	+

Table 5.2 (Contd.)

DIRECTION OF TOTAL IMPACT OF INVENTORY HOLDINGS ON PRICE-COST MARGIN

Name of Industry Group and Firms	Obtained Through the Disaggregated Model (Chapter 4)	Obtained Through the Full Model (Chapter 5)
Shri Digvijay Cement Co. Ltd.	+	+ *
Madras Cement Ltd.	−	+ *
14. PAPER INDUSTRY		
Balkrishna Industries Ltd.	−	−
The Mysore Paper Mills Ltd.	+	+
NEPA Ltd.	−	+
Shesasayee Paper & Board Ltd.	+	− *
Star Paper Mills Ltd.	−	+ *
Ballarpur Industries Ltd.	−	− *
15. FERTILISER INDUSTRY		
Dharamsi Morarji Chemical Co. Ltd.	+	+
Excel Industries Ltd.	−	+ *
Fertiliser & Chemical Travancore Ltd.	+	+
Gujarat State Fertiliser Co. Ltd.	+	−
16. CHEMICAL INDUSTRY		
Aegis Chemicals Ltd.	+	−
Citurgia Biochemicals Ltd.	−	+ *
Gujarat Alkalis & Chemicals Ltd.	−	− *
Polyoefin Inds. Ltd.	+	−
Deepak Nitrides Ltd.	+	− *
17. PAINT INDUSTRY		
Garware Paints Ltd.	−	+ *
Goodlass & Nerolac Paints Ltd.	+	− *
Berger Paints Ltd.	+	+
Asian Paints Ltd.	+	+
18. ALUMINIUM INDUSTRY		
Hindustan Aluminium Corporation Ltd.	−	+ *
Indian Aluminium Co. Ltd.	−	− *

Table 5.2 (Contd.)

DIRECTION OF TOTAL IMPACT OF INVENTORY HOLDINGS ON PRICE-COST MARGIN

Name of Industry Group and Firms	Obtained Through the Disaggregated Model (Chapter 4)	Obtained Through the Full Model (Chapter 5)
19. GLASS INDUSTRY		
Borosil Glass Works Ltd.	+	+ *
JG Glass Ltd.	+	+
Indoasahi Glass Co. Ltd.	+	−
20. IRON AND STEEL INDUSTRY		
Bihar Alloy Steels Ltd.	−	+ *
Ferro Alloys Corporation Ltd.	−	+ *
Graham Firth Steel Product India Ltd.	−	+ *
KEC International Ltd.	−	+ *
Mukund Ltd.	−	+ *
Rathi Alloys & Steels Ltd.	+	+ *
Steel Tubes of India Ltd.	+	+
Bharat Forge Ltd.	+	+
21. MACHINERY INDUSTRY		
Atlas Copco India Ltd.	−	−
Kirloskar Cummins Ltd.	−	− *
Kirloskar Pneumatic Co. Ltd.	+	+ *
The Mysore Kirloskar Ltd.	+	+ *
Punjab Tractors Ltd.	−	+ *
Ruston & Horsby India Ltd.	−	+ *
Kelvinator India Ltd.	−	+

* Shows that β coefficient is significant (i.e. 't' $\geq$ 1).

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 THE PERSPECTIVE OF THE STUDY AND MAJOR FINDINGS

The primary focus of this study has been an analysis of the relationship between profitability and finished product inventory in different Indian industries at the firm level.

There are several factors which motivate a firm to hold inventory. Different economists have talked about different motives for holding of inventory such as to get cost advantage or price advantage or both. But the existing literature has so far ignored the impact of holding of inventory on the performance of the firm. Since performance of a firm is determined by cost and price together, therefore, there exists a relationship between holding of inventory and performance of the firm. How different motives of holding inventory eventually affect this relationship formed the important issue for study in the present thesis.

Five main motives for holding inventory were investigated in the study. They are:

(i) Inventory is held to enjoy the advantage of economies of scale in the production process.

(ii) Demand for a product is positively affected by the product availability and this motivates the firm to hold inventory.

(iii) Inventory is held to reduce the randomness in the demand curve.

(iv) Inventory is held to deter the entry of new firms and

(v) Inventory is held to enjoy the speculative advantage in the market.

The first motive of inventory holding listed above affects the cost aspect of the firm while the remaining four motives affect the demand aspect of the firm.

Price-cost margin was taken as the measure of profitability. The theoretical framework analysing the relationship between price-cost margin and inventory holding was developed under each of the five motives listed above in the present study. The theoretical model showed that inventory has a positive impact on the price-cost margin under all the motives except reduction in demand uncertainty motive of inventory holding. The relationship under demand uncertainty motive was theoretically studied under three conditions - (i) when the firm is a risk taker, (ii) when the firm is a risk averter and (iii) when the firm is risk neutral. The relationship between the price-cost margin and inventory holding was found to be negative under demand uncertainty motive only when the firm is a risk taker. In the other two cases under this motive the relationship emerged as positive.

At the next stage the relationship between the price-cost margin and inventory holding was studied empirically for different Indian industries at the firm level. The initial aim was to study

the relationship empirically under each of the five motives separately. But it is very difficult to separate out the effect of inventory on price-cost margin under increase in demand motive, reduction in demand uncertainty motive and speculative motive unless we are given the information regarding how much inventory is held for each of these motives separately. Unfortunately such information is very difficult to compute from the available data in India. As described in Chapter 4 the reduced form equations of demand and average cost functions under increase in demand motive, demand uncertainty motive and speculative motive are the same. Since it is not known out of the total inventory how much inventory is held for increase in demand motive, how much for demand uncertainty motive and how much for speculative motive, the impact of these three motives are contained together and cannot be separated out. Thus, the impact of inventory on price-cost margin was not tested empirically under each motive separately.

Whenever inventory is held to satisfy the economies of scale motive it affects the cost function of the firm whereas whenever inventory is held for any purpose other than economies of scale motive, it always affects the demand function of the firm. Thus, in view of the above, the variation in the price-cost margin was separated out under two effects only, that is (i) variation due to cost factor and (ii) variation due to demand factor. The first case incorporated the economies of scale impact on price-cost margin while the second case incorporated the increase in demand impact, demand uncertainty impact and speculative impact of holding inventory all together on the price-cost margin.

There may be some unintended accumulation of inventory also in some cases. Thus, for the purpose of this study wherever it was found that inventory was not held for any of the above mentioned motives, then that accumulation of inventory was treated as unintended inventory. The impact of such unintended inventory is also incorporated in the demand and average cost functions. Thus, such inventory also affects the profitability of a firm and its impact was also studied alongwith the impact of intended inventory in this study.

The basic source of data for empirical study was the Stock Exchange Official Directory (1990). This was supplemented with data from Centre for Monitoriing Indian Economy, CMIE (1990) publications. From these two sources information about sales, price, production, finished product inventory and average cost of different firms was computed and demand and average cost functions were estimated for the different firms. The simultaneous equation framework was used to compute the impact of finished product inventory on the price-cost margins of different firms under the cost factor and demand factor separately.

At the end of the empirical analysis a simple regression model was run in which price-cost margin was assumed to be a function of inventory holdings considering the demand and cost factors together. This was done to find the overall impact of inventory on the price-cost margin.

The sample for the purpose of the empirical analysis represented the organised sector only and consisted of 85 firms of 21 Indian industries.

To study the relationship between inventory and price-cost margin empirically the industries were divided into four broad categories namely consumer non durable, consumer durable, producer non durable and producer durable product categories.

The results of the empirical analysis describing the relationship between inventory and price-cost margin under the cost category and the demand category separately showed that cost impact is mostly positive for the consumer non durable, consumer durable and producer non durable categories while it is negative for some firms of the producer durable group. This result indicates the existence of economies of scale in the industries of the consumer non durable, consumer durable and producer non durable industry groups. The demand impact was observed to be positive for most firms of the consumer non durable group indicating that consumers respond to availability and there is favourable valuation of a firm's product by them. In the consumer durable industry group the demand impact is mostly negative indicating the unintended accumulation of inventory by most firms in this industry group. This might be due to a recessionary situation prevailing in most of the industries under this industry group. In the producer non durable group there are two industries namely paint and chemical industries in which the demand impact is mostly positive while in case of cement and paper industries this

impact is mostly negative. Thus there is no clear cut trend of demand impact visible in this industry group. In the producer durable product group the demand impact is again not clear. This implies an effective inventory management policy in some firms and the reverse in other firms of different industries in this group. Thus, in this industry group inventory management plays an important role and is a must to reduce any unintended accumulation of inventory. Besides this, the results showed that inventory is held by most firms of all industry groups to satisfy at least one motive of inventory holding, that is, to satisfy either the cost motive or the demand motive.

The empirical results of the full model showed that inventory has a positive impact on the price-cost margin in the case of all the firms comprising the industries of the consumer non durable broad category. In the case of the other industry groups the relationship between price-cost margin and product inventory is not clear. In the case of the consumer non durable industry group inventory management does not have much role to play as the sales time of inventory is very small in this industry group and thus the relationship between price-cost margin and inventory does not differ from firm to firm. On the other hand, sales time of inventory is sufficiently large in the case of consumer durable, producer non durable and producer durable industry groups and thus inventory management has an important role to play in these industry groups. It can be concluded from the regression results that the firms which have good inventory management show a

positive impact of inventory on their price-cost margins and vice versa.

6.2 LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This study is not free from limitations. Firstly, the impact of inventory on price-cost margin could be studied empirically only under the cost category and demand category. As explained earlier the demand category incorporated three different motives viz. increase in demand motive, demand uncertainty motive and speculative motive of inventory holding. This thesis could not study the relationship between price-cost margin and inventory separately under these three motives.

Secondly, inventory was assumed as an exogenous variable throughout the study. This assumption had to be made keeping the objective of the study in view. However, the reverse can also be assumed.

Thirdly, this study is based on the assumption that a change in inventory is brought about only by changing production but the change in inventory can also be brought about by changing volume of sales.

Fourthly, when we compare the total effect of inventory on price-cost margin (as computed in Chapter 4) with the total effect of Chapter 5, we find ambiguity in some cases. The reason for this ambiguity is that the results of Chapter 4 are based on certain assumptions (as explained in Chapter 5) whereas in the direct model of Chapter 5 no such assumptions are applied.

However, in most cases where there was ambiguity, the coefficients were observed to be insignificant.

Inspite of these limitations this study has several plus points. It is a pioneering work of its kind and the results of the study can help firms in deciding their inventory policy in such a way so as to increase their profit margins.

The study yields good material which could be used for further research. Further research should attempt to study the price-cost margin - inventory relationship separately under the five motives mentioned in the study and any other motives also.

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